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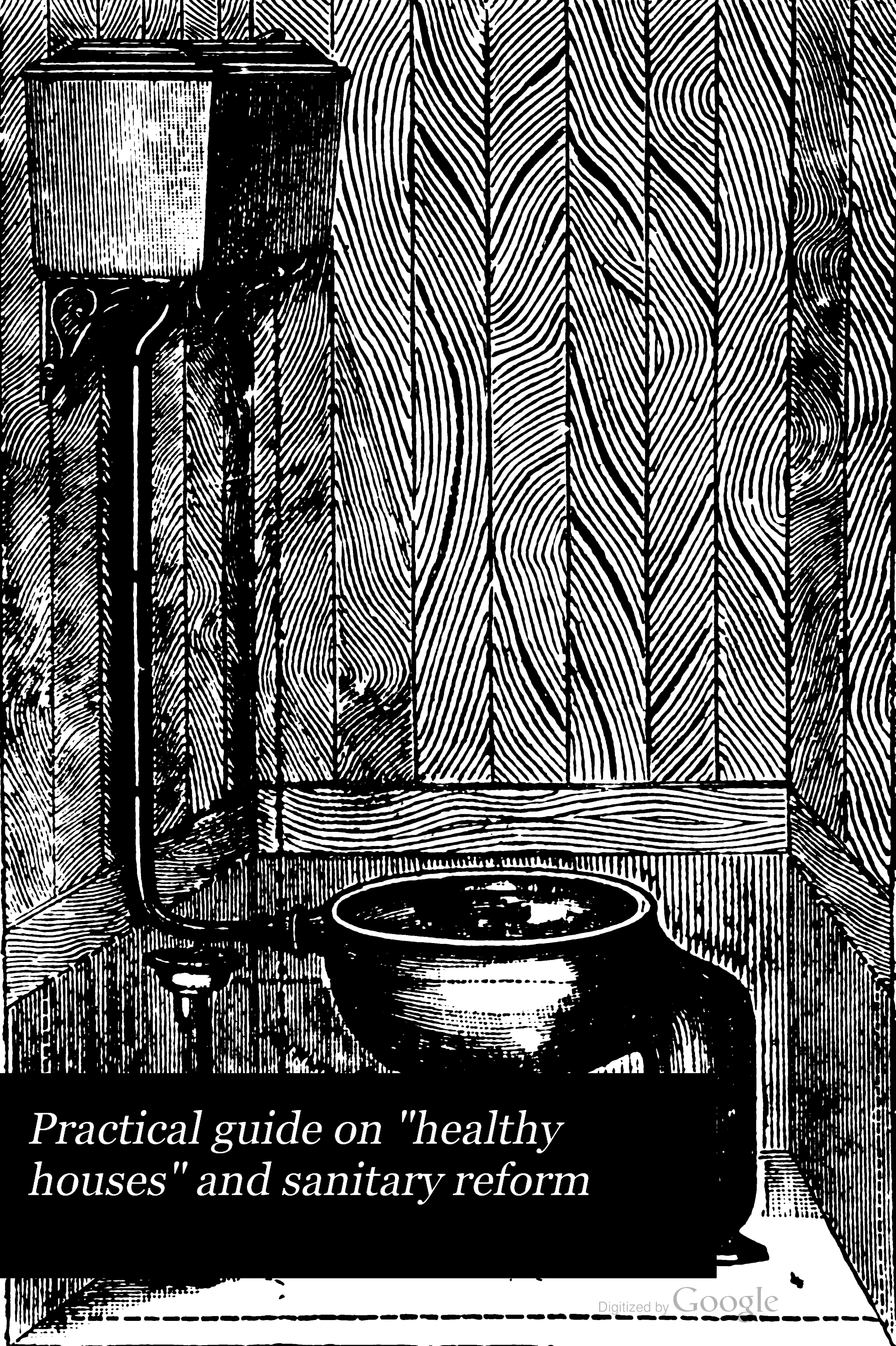

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PRACTICAL GUIDE

ON

"HEALTHY HOUSES"

AND

SANITARY REFORM,

By JOHN ALLAN,

ARCHITECT AND SANITARIAN.

◆

The special points treated in the book are Locality, Site, Axis and Level, Foundation, Structure, Walls and Roofs, Water Supply, Trees as Sanitary Agents, Drainage, Earth-Closets, Ventilation, Lighting and Heating, The Interior, Hints to Householders, Education and Legislation, The Poor and their Domiciliation.

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INTRODUCTION.

HOUSE SANITATION, and Social Reform, are as intimately bound up in each other as personal cleanliness, purity of habits, and moral healthiness, generally, are interwoven with them;—the growth and maintenance of moral and physical prosperity are thus largely affected by the nature of domiciliation, healthy or unhealthy areas. In these circumstances, any emotional digression or humorous infusion to relieve the monotony or dryness of the subject in the pamphlet, will, it is expected, be pardoned. Technical words and phrases are avoided or explained, as much as possible, in making the work available for all classes. While the pamphlet points out public or private existing evils in the occupation, or construction of houses, or in the sanitariness or order of cities, remedies are also suggested.

Whether it does so in a manner too theoretically or less practically, or however poor it may be expressed, yet its *aim* is not for the destruction of human happiness or the reduction of the nation's well-being, but, simply, to point out a desiderated measure of improved domiciliation, including personal, domestic, and local cleanliness, in the observance of which much preventible disease may be obviated, the welfare of the individual and society augmented, and reflected in the greater health and wealth of the nation.

THE AUTHOR.

I. LOCALITY.

Trees, besides the poetic grace, and sacred privacy they lend a house, however rude or even vulgar it may in itself be, afford considerable shelter to it in a situation where it would otherwise be exposed to piercing winds. By their power of absorption and evaporation, moreover, they contrive to render a double benefit—to cool and moisten the air when it is dry and sultry, and to dry and purify the air when surcharged with moisture. Forests, for example, in this last respect, play a part not unlike that of a range of hills, though in a less degree: both tend to relieve the winds of their excess of moisture. It is calculated that for every pound of woody fibre formed, a plant evaporates 200 pounds of water, which it has first to drain out of the air and soil, into which again that water in part returns by the evaporation of the plant, in accordance with the process of circulation, which may everywhere be traced in nature. Districts, marshy, damp, and malarial, have been and may be transformed into sweet and wholesome, or comparatively sweet and wholesome stretches, simply by the plantation of gum and pine trees which know how to act on putrid air, and employ to their own, and to human benefit, gases, which were only a nuisance when left to themselves. Mountains, while draining the moisture of the winds, lower the temperature of the immediately surrounding region, and a house exposed to breezes from the hills or mountains will be so much the colder in winter, while, of course, enjoying so much more bracing and agreeable air in summer. Every 300 feet above the sea is a reduction in the temperature to the extent of one degree. The air on the sunny side of hills, as it gets warmed, flows down into the valleys, where it accumulates, and at night produces corresponding currents of cold air from the hills. The ground absorbing heat during the day radiates it during night, but an elevated piece of ground continually blown over by cooler air is continually losing instead of saving the heat it gains. The nature of the soil immediately surrounding a house, the character of its environs, and its exposure or non-exposure to sun and wind, are all elements in the determination of the temperature and health of any residence. Low-lying grounds, especially if undrained or ill-drained, are the haunts of murky vapour, from which the higher elevations are comparatively clear. But these are general considerations more or less obvious to every one, and do not need to be enlarged on.

II. SITE.

THE surface of the earth is constantly being affected by the varying states of the atmosphere in respect of temperature and moisture, to a depth of probably three feet at least, on account of a giving and taking, or the endeavour to maintain a just balance in these respects, being continually in process between the atmosphere and the earth to that depth. Not till a depth of seven feet is reached can the earth be said to be quite uninfluenced by atmospheric changes. Loam, clay, and rock are better conductors of heat than sand—that is, the three former offer less obstruction to the passage of heat downwards than does the latter. As a necessary corollary of this proposition, sand retains the heat much better than loam, clay, or rock. The following is a table of the different heat-retaining powers of different soils:—

Sand, with some lime, ...	100 per cent.
Pure sand, ...	95·6 „
Light clay, ...	76·9 „
Gypsum, ...	73·2 „
Heavy clay, ...	71·11 „
Clayey earth, ...	68·4 „
Fine chalk, ...	61·8 „
Humus, ...	49 „

Sand and gravel are thus at once the worst conductors and best retainers of heat, while ordinary rich mould is exactly the reverse. As regards capacity of retaining water, on the other hand, red sandstone will hold absorbed in it as much as 27 gallons for every cubic yard; pure sand is able to absorb as much water as 17 per cent. of its own weight when in a dry state, and peat 103 per cent. Sand is a conductor, peat, rock, and clay retainers of water. The passage of water and air is much easier in a sandy or gravelly than in any other soil. A sandy or gravelly soil is, consequently, so much healthier, provided it is not already choked by water, sewage, or decaying organic matter. Sand, being a ready absorbent, will take up sewage impurities much more easily than clay does, and fever has frequently been observed to confine its range to its original sandy area, stopping with the commencement of a clay soil. The sandy bottom and environs of Berlin, *e.g.*, have thus become contaminated by sewage to such a degree that the offensive effluvium rising therefrom in the hot summer is all too perceptible. Cesspools or dunghills, in regard to their situation, on a porous soil, and in the vicinity of water which is used for domestic purposes, or even for the mere washing of culinary or dairy utensils, must be regarded with grave suspicion. If a soil, below, or surrounding any habitation becomes polluted from any source, the ground air, which is naturally impelled into the stronger current from the greater heat in the interior of the house, serves as an additional active agent in the dissemination of the poison. All soils contain ground-water more or less. "If the water lies less than 5 feet from the surface, or the ground has a fluctuating water-level, the site is liable to be damp. Probably not until a 16 feet water-level is reached can the soil be said to be securely dry." When water fluctuates in the ground, decayed organic matter is apt to accumulate, to be carried thither at each flow and left at each ebb. If a low water-level cannot be maintained by draining, an even water-level ought at least to be secured. Sites near graveyards, polluted streams, or more or less composed of town-refuse, are always evaporating putrefactive gases or poisonous germs of vegetable or animal nature, ever liable to be blown or borne by every gust or gentlest air of wind into the interior of the house. The Report of Dr Buchanan on "The Sanitary Conditions of several Districts in the South-east of England" (which point he was appointed by the Privy Council to investigate), says he found that—

"(1) On pervious soils there is less consumption than on impervious soils.

"(2) On high-lying pervious soils there is less consumption than on low-lying pervious soils.

"(3) On sloping pervious soils there is less consumption than on flat impervious soils.

"(4) These conclusions are further supported by the fact that artificial removal of subsoil water alone, of various sanitary works, has largely diminished consumption."

Phthisis, it thus appears, increases with the dampness and decreases with the dryness or improved drainage of the soil. In agreement with this fact the death-rate from this, as from other infectious diseases, is found to vary in large measure according to the different qualities of the soil. Germs of infectious diseases, of whatever kind, diphtheria, typhus, pox, phthisis, cholera, cattle diseases, &c., are now ascertained to be minute organisms, vegetable or animal. The disease increases in any patient by the multiplication of these organisms, and enlarges its area by the conveyance of these organisms from patients to new subjects. Now, the facility or difficulty of the propagation and conveyance of these organisms is conditioned by the state of the atmosphere, which, again, is largely dependent on the of the soil, and by the state of the persons to whom the germs are transferred. When health is below par the body offers so much less resistance to the admission and lodgment of any germs that may be floating about, and is so much less able to expel the enemy after it has taken possession. In a struggle of this kind, a vitiated soil, and consequently, a vitiated atmosphere, lend their whole assistance to the foreign aggressor, and do all the injury in their power to the poor defendant, who, in such a case, will generally find that the best leech he can summon to his rescue is altogether inadequate.

With reference to artificial sites, if a sufficient time is allowed to elapse before building is begun, they no doubt become so far oxygenised, and, therefore, the less likely to be pernicious. But, even in such sites, in which decay has become quiescent, it is advisable to adopt such precautions as will arrest any upward movement of ground air, and so prevent its admission into the interior of the building, by covering the entire area of its foundation by an impervious material.

III. AXIS AND LEVEL.

In laying out new areas for building purposes, the first point to be observed is to dispose the row, street, terrace, or line of houses to be erected topographically in such a manner that the houses when built will enjoy the utmost amount of sunshine—that is, that they may present the greatest area of surface for the longest possible period of time throughout the year to the rays of the sun, and that the height of the houses to be built will not be out of proportion to the width of the street. In this northern climate a house is in no danger of too great sun-exposure. Another important point is to give the houses such an elevated situation as to secure rapidity of drainage. Seeing, again, that the warmer state of a dwelling-house induces an upward current from the ground on which the house stands, it becomes, thirdly, another point of importance to give the ground floor such a high level as will admit a free passage of air across the entire area between the ground and the raised floor. By such construction the upward tendency of the air is diverted in whole or in part laterally, the site immediately under the house gets perpetually winnowed of its dampness, and the building from its very basement is thus so much the more maintained in a dry and wholesome state, at once conducive to its own preservation and beneficial to the health of its inhabitants. It is hardly necessary to illustrate the value of raising the ground floor by pointing to the well-known fact that, in military campaigns, the health of forces sinks very much lower when they are squatted closely on the ground, than when quartered in tents raised a certain space above the earth. Basements are not well suited for the culinary and other menial service of a house, which ought to be relegated to a wing on the ground floor, separated in such a manner from the body of the house that nothing of the noise and offensive smells connected with that service will penetrate into the part appropriate to other purposes. In large public buildings, where there is a culinary department, its best place, when such an arrangement is otherwise unsuitable, is, perhaps, in the topmost storey of the house.

IV. FOUNDATION.

THE application of an impervious material to the walls rising at a line a little above the surface of the ground and under the level of the basement floor prevents both the dampness of the soil and the ground air from rising in the walls. In houses in which such a provision has been made, a distinct line of demarcation may be observed immediately below the asphalte, shewing the terminus of the ground damp. A form of fibrous asphalte has been found specially suitable for walls on account of its flexibility, readily yielding, as it does, to any partial or general "sit" of the walls, and also because of the ease with which it can be applied. The more solid and brittle asphalte, composed of bitumen and sand, or concrete-cement, is best adapted for covering areas inside the walls on which the house stands. A series of ventilated openings perforating the external walls above the surface of the ground, and under the level of the floor, and communicating with openings in the internal walls, or with flues in the case of large spaces, would carry off all damp, and prevent the phenomenon of dry rot or the formation of fungous growths. The walls should likewise be furnished with openings admitting personal access to all parts of the interior basement area.

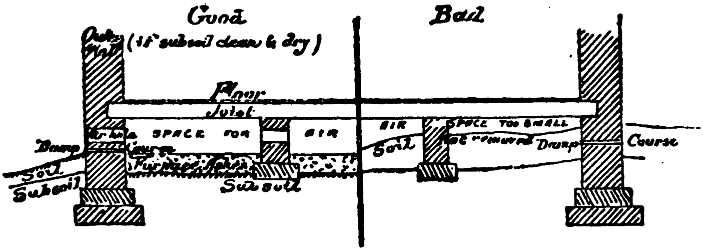


FIG 6

The ends of wooden beams or joists in contact with the walls, unless open to continuous ventilation, get affected by dry rot, as may very readily be seen when taking down old buildings. In such an event the ends of the joists are all decayed or utterly wasted away. The ends or "holds" of the joists, wasting, the floors sink, and the stability of the house itself is imperilled. By the device, however, of embedding the ends of joists resting on and built into the walls with dry stones all round them, or fitting them into fire-clay shoes, and causing a free current of air to play on them, they will be made capable of lasting as long as the other parts of the wood not in contact with the walls. In cases in which ventilation cannot easily be brought to bear on them, the ends of the joists should be steeped in muriate of zinc, coal tar, chloride of mercury, or slightly charring the timber after it has been seasoned, which will render them at anyrate so much less susceptible to dry rot.

On account of their porous nature and their consequent tendency to absorb damp from the soil, as also because they are apt to generate saltpetre when in contact with the earth, bricks are not suitable for foundations. Certain brick compositions, moreover, contain soda, potash, magnesia, organic substances, or sulphur, elements which, in combination, two or more of them are favourable to growths and to the accumulation of moisture in the walls.

When a wall is built against elevated ground, a current of air is liable to find its way from the earth to the structure leaning on it. To prevent this occurrence, the side of the wall in contact with the earth should be coated with a non-absorbing material, or two walls should be built, one resting immediately against the earth, and another at such an interval from the first wall as will allow free ventilation between them.

Concrete, stone, or brick laid on the earth in the formation of ground floors are usually productive of damp, which does not occur with the same materials laid on upper floors, as the equal states of the spaces above and below impart hardness, dryness, and durability, especially to concrete material. When these materials are placed on the earth, the dryness of the room or space has such a violent attraction for the moisture below, and that moisture being anxious to liberate itself for assimilation with the dryness above, saturates the solidified floor-substance in the struggle. The atmosphere communicates its varying states to the earth, which in turn conveys its condition to the floor-substance, by which that medium is softened, disintegrated, wasted, and the surface more or less rendered uncomfortable. The arrestment of ground-air and damp is obtained in a non-absorbent and non-conducting medium between the earth and the floor, found in highly-vitrified brick, in a layer of asphalte below the floor composition, or in the provision of hollow spaces admitting of a sufficient current of air underneath the surface, or in laying the floor with such other composition possessing non-absorbent and non-conducting qualities.

V. STRUCTURE.

THE structure of a house, irrespective of its size, the number of individuals or families it is designed to accommodate, the greater or less elaboration or completeness to be allowed it, the time it is intended to last, the material for building at command, and other minor modifying points, is to be determined by the climate to which it will be subjected—the duration of cold throughout the year, the maximum degree of cold reached, the duration and intensity of rain, wind, vicissitudes of temperature, sunshine, &c. Though, it is true, that many houses are built, as if in spiteful defiance of the climate, or apparently under the belief that the climate will politely accommodate itself to the style of house, instead of inexorably dictating, beforehand, the style in which a house must be built. The climate has to determine—wholly, or at least in large measure—the thickness and composition of its walls, the nature of its roof, the multiplicity or paucity of its windows, passages, porticos, &c.; general solidity or lightness, compactness or diffuseness, the contour of its facings, the character and amount of its ornamentation, the kind of walls or fences enclosing it, and many other points. The house must be built so as to receive a sufficiency of light and air—and in this climate as much light as possible. Another point to be considered is whether it is to be provided with an earth or water-closet apparatus, and well planned it will be, if it suit either. Every house ought, further, to be built so that, without serious inconvenience or expense, it, and its apparatus may be inspected in every part in case of accident, injury, or wear, or in the ordinary course of events.

In the case of tenements or self-contained houses for the artizan or labouring classes, it would be well to build them not contiguously, according to the arrangement now generally prevailing, but each isolated from its neighbour by an intervening space on either side. The back and front of each row of houses should again be separated from the next row by a wide street or area. Each house or block of tenements would thus have its own completely-investing and ever-renewed current of air. By this plan hardly any more ground would be required in the case of parallel streets or squares than is used by the present system, which supplies confined and usually ill-ventilated courts and areas. The streets and open squares might, with little expense, be planted with trees, and at certain intervals be supplied with running fountains open to the eye of day. Besides, or partly in virtue of, the purification and vitalisation they would effect of the vitiated and dusty air, the green leaves in summer, or even the bare boughs in winter, would be a perpetual source of freshness both to sense and mind of the boyhood, manhood, and old age of the otherwise arid and artificial city, and by their physical and moral benefit, by the virtue they fostered, and by the vice they checked, would abundantly repay the extra outlay they might at first involve. It may also be expected that public spirit and local pride might in this way, too, be excited and stimulated, and that many a citizen who had grown to competence and wealth would deem a part of his savings well spent, if, in the erection of a fountain or swimming bath — the adornment of his part of the town — the personal cleanliness and benefit of the fellow-citizens who had contributed to his fortunes were increased thereby. An example of this kind would be readily followed, and no town need want its sylvan or rural-like interspaces if only a proper beginning were made. Our lowest classes have hitherto little benefited, either materially or morally, by the progress of mechanism and science, and are now, perhaps, sundered and alienated more than ever they were from capital and rank. Let at least a beginning towards improvement be made in this primary and important direction, and improvement might perhaps be awakened in other still more imperative respects as well. But to return to a closer dealing with our subject—back courts and hidden areas serve at present mostly for the accumulation of rubbish, for the keeping of hens, pigeons, rabbits, dogs, &c. Back areas thrown into common breathing and promenading recreation spaces, would on the other hand be much more healthy and enjoyable, and in any case be more open to sanitary inspection and control. Let not foul air and uninhabitable houses co-operate with other agencies in driving people to the public-house. A well-built house, healthy and comfortable, pleasing at once to the eye, to all the senses, and to the mind, need hardly be more expensive than an ill-built house, unhealthy and uncomfortable, a plague at once to the eye, to all the senses, and to the mind—might, indeed, be much less expensive than in the case of many houses of the latter description. The builder of a house ought to be responsible to the Board of Works for the health of the house, as far as the mere building is concerned, which, of course, vitally affects the neighbourhood, and also, in part at least, for the agreeable figure of the house and its civil adaptations in this respect to adjacent houses—a feature which also seriously affects all the inhabitants of the same community and every by-passer.

In the case of houses let out to a number of families, each tenement or dwelling ought to be self-contained, and entered directly from the outside. The staircase conducting to different flats should be quite open to the atmosphere. Each tenement, even if of only one room, must be provided at least with a press for food, a closet for culinary utensils, and another for clothes, while, in the case of only one room, a screened-off corner for a bed is indispensable. A three-roomed tenement might be of the following description:—Entering from the balcony or landing, there would be a large room occupying most of the total space, partitioned off by brick or concrete, either into two bedrooms or into a parlour and bedroom, as might be the most suitable, the rest of the space serving for the kitchen. The water-closet, sink, and coal-bunker would be placed outside in the landing or in an offshoot. Particular spaces would have to be reserved for soil-pipes, hoists, and dust-shoots, while wash-houses, clothes-airing spaces, and baths for both sexes would occupy the roof.

A tenemental house of this construction would be economical to build, and economical to the people occupying it, while privacy and the largest share possible of light and air would be at the command of every family. In the case of tenemental blocks, the stairs would be open and common to the right and left tenements, and each house entered by a gate, separating its little outer entrance balcony from the common stair and landing.

An interior arrangement of water closets is in every case objectionable. Even at best it is more or less noxious, and when there is any temporary derangement of the apparatus, its offensiveness calls loud for another contrivance. Water-closets ought, therefore, to be kept apart in offshoots or annexes entirely separated from, and outside the walls of the main building. Their best place is against an external wall, in which case the space between them and the house should be swept by cross-ventilation, or, where possible, they should be placed outside the walls of the house altogether.

VI. WALLS AND ROOFS.

WALLS and roofs fulfil their purpose to the extent that they isolate the interior from the exterior, and present an impassable degree of barrier between the inside and the outside, so that the moisture and temperature on the one side have only a porous communication with the moisture and temperature on the other. Perfection of walls and roofs has not yet been attained, if it is at all attainable; Pyramus on one side and Thisbe on the other have ever managed to discover some vent through which to whisper their several states to each other, and their desire to unite.

Decaying Material.—Air passing outwardly or inwardly through decaying walls and rotten wood, or through ground charged with sewage, or blowing over or through refuse around certain classes of property, no doubt carries oderous message-particles of its contact to the in-dwellers or by-passers.

The degree of ventilation is proportioned to the difference of temperature between the interior and exterior air, and the amount of porosity on the part of the walls and roofs. Excess of moisture, carried from the outside through the walls, is seen in drops of water trickling down, or currents pouring down the interior surface. Condensation of air, in contact with cold, non-absorbent surfaces, produces similar results. Walls and roofs, again, absorb organic matter from the inside, and exhale it more or less in turn. Substances which will render a wall least porous are, therefore, if suitable in other respects, best adapted for the construction of walls and roofs. Sea-sand ought on no account to be used instead of pit-sand in the building, and plastering of walls, seeing that it not only discolours them, but, by the salt which it contains, retains moisture much more than does pit-sand, and sweats, to a greater or less extent, in moist states of the atmosphere—an evil which can never afterwards be properly remedied. A wall of concrete-cement, formed in mass and with few jointings, will resist the intrusion of damp much better than brick; and, in point both of strength and dryness, it is calculated that a 6-inch wall of concrete is equal to a 9-inch wall of brick. For internal walls, roofs, inter-tenemental floors, stairs, landings, passages, basements, and areas, concrete is perhaps superior to any other substance. Gravel, sand, and cement are all that is needed. The concrete thus produced, will adapt itself to any shape, such as smooth, or rough surfaces, by which a ceiling, floor, or internal wall, may be smoothed into a comparatively impervious surface, or a floor prepared to receive wood boarding, wood blocks, or tiles, is available for either skilled or unskilled labour, is fire-proof, and may be employed for the whole material of a house, barring doors and windows; and commends itself altogether as the substance best adapted for cheap and comfortable workmen's houses, particularly in the case of metropolitan displacements. Concrete, plaster, and brick, being fire-proof materials, are suitable for embedding iron. If iron is used in combination with concrete for internal floors, or partitions of tenements, instead of wood, the mass becomes not only more substantially possessed of fire resistance, offers less harbour for vermin, but, in addition, its solidity tends to prevent the conveyance of unhealthy exhalations from room to room, and flat to flat. The prevalence of open, or more or less porous divisions of wood, lath-plastered partitions, and wood-joisted floors in tenements, are thus a means by which disease is preserved, and conducted from family to family, and house to house. A room, or dwelling, or the space above or below it, which may also be in a like condition, will have its unwholesome state not less intensified by the less solid communication. Brick is especially porous, and absorbs damp largely, more particularly when thin and solid. Walls, whether of stone, brick, or concrete, are usually built solid, though this is a mistake. If walls were built with a clear *lacuna*, or hollow space running through their middle, the moisture from the exterior would there be intercepted, or suffer discontinuity, there would be an easier approximation of temperature; and the consequence would be a great gain in dryness and healthiness to the interior. Stone is, perhaps, not so well adapted for such lacunar building as is brick; and in this manner the best plan is to build a stone wall on the outside and a brick wall on the inside, or both walls may be built of concrete, a sufficient space being, in any case, left in the interval for ventilation, or a space occupied by a layer of asphalte, for the purpose just described. Plaster, in conjunction with wood straps and lath, dooked to the inside of walls, gives n air space; but the plaster is more liable to breakage n when applied to brick lining. In the case of a stone or brick wall, their lower part, in many cases, should be formed of the glazed or coloured variety of brick, which make a clean and substantial lining.

The *Building News* says:—"There is the requirement (1) of an impermeable facing to throw off the wet; and (2) of an inner casing or skin of a non-conducting substance. . . . . All hygienists and constructive architects have declared in favour of a principle of wall-building which preserves an air space, and which can be turned to any useful purpose, while it fulfils all the conditions of a sanitary wall."

There is a marked difference, in point of sanitation, between a solid and a hollow wall, as the solid wall of porous material offers ready means for the transmission of damp from the outside to the inside, and unless the solid wall is protected from that transmission by a vertical layer of asphalte up its centre, or in a more or less covering of impervious substance outside, or by a layer of heat-retaining and fire-damp-resisting material on its internal surface, or built of considerable thickness, it cannot possess the qualities attributed to the wall with hollow ventilated spacings.

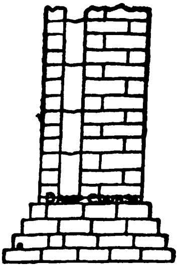


FIG 3
HOLLOW BRICK WALL

Captain Galton estimates that each brick will absorb from 7 to 10 per cent. of its weight in water, and that a new house, in which 100,000 bricks have been used, consequently holds absorbed in its walls 10,000 gallons of water.

A small intermediate space, filled with asphalte, in the centre of solid brick walls has been successful in arresting the lateral conduction of moisture through them. It is not only necessary to provide against damp being conducted to the interior from the earth beneath upwardly, or from the atmosphere laterally, but also from the heavens downwardly; by likewise providing the walls rising above the roof, chimneys, balustrades, &c., with a coating of impervious asphalte below copings, or where it can be best applied immediately above the roof line. For existing buildings of stone or brick that are porous, or soft, or inclined to waste, a colourless preparation of silicate of soda and chloride of calcium is an appliance for rendering walls comparatively inactive in these respects.

The economical conservation of heat, or the prevention of too much of its loss, and a more diffused internal degree of warmth, point to a lining of brick, plaster, or papier-mache for the inside of walls. The loss of heat from a room is greater through a granite wall than through a sand-stone one, through brick two-thirds less than in sand-stone; while plaster and paper compositions are the least losers of the heat they obtain. Brick, plaster, and paper are thus absorbers, retainers, and surfacial reflectors, and do not so readily convect the heat from the room as colder materials.

In the building of a sanitary wall, there is the seasoning of the stones by evaporation of their natural sap, testing their consumptive qualities before being built, the condensating powers of granite, conglomerate, and slaty rocks, the absorbing qualities of sand-stone, the drainage of walls and protection of the interior for liberation and intrusion of moisture, the protection of timber—as already recommended under "*Structure*"—from moisture liable to be capilliarly attracted, are all characteristics for consideration, as well as the increased or diminished stability
anner of laying the stones for obtaining uniform
on of their burden and extensile strain. When

stone is immediately taken from a wet quarry, impregnated with moisture, and immediately deposited in the building unwinnowed, it conveys its damp to the timber, which is readily absorbed by the wood in contact. The building comes to have an enclosed warmth, and as moisture and heat are conditions favourable to parasitic growths, the timber becomes parasitically affected, and of course decays.

Substantial building means also, in addition to the stones being equally yoked, their lying on their natural beds, and so mortared that no stone comes in contact, as too many of them do, without a due modicum of that binder. Wise builders, however, will not reduce their lime with too much sand, thereby risking the downfall of their erection; and, especially for "pointing" purposes, it is always unprofitable using reduced lime, which will neither glide to the trowel nor stick on the wall, but in great part fall to waste; besides, its application swallows up more time.

Approximately comparing the equal crushing weight of stone and brick, if these are taken at 200 to 300 tons, the granite formations (almost uncrushable) may be put at 700 to 900 tons per square foot. The selection of stone for great cities, possessed of ingredients capable of resisting chemical elements, in a pecuniary sense, is none the less important than their reduction and the mitigating of those elements so destructive to human lungs. Stones are not unlike animals, which, when subjected to air-impurities afloat in cities, become mangy and lose themselves in dust and scales, being preyed upon by infectious and contagious germs.

What have the Houses of Parliament not cost the country for stimulants, and what will they not cost in the future for antiseptics, on account, in the first instance, of an unwiseness in calculating the requirements against London fog, acid, and dust?

It has been jocularly remarked that buildings composed of magnesian limestone, on which an application of "*dilute* *sulphuric acid,*" partial ingredients of London air, constantly takes place, has a tendency to reduce or change them into "*epsom salts*".

ROOFS.—In the case of an inhabited garret under a slate roof, a layer of fibrous asphalte, or fire-proof felt, between the boarding and the slates, will serve to intercept damp, and, by checking the access of cold in winter and of heat in summer, will go towards maintaining a uniform temperature in the interior; or instead of slates, cement might be used to cover roofs—the cement offering a resistance equal to that of asphalte to the entrance of moisture or temperature. Cement, moreover, being a noiseless ingredient, can be employed in the formation of promenade or pleasure elevations, or, in the case of street buildings, for purposes of traffic, bathing, or clothes-washing.

Roofs covered with slates or tiles, especially in cities, are ever ready in storms to be blown off, to fall possibly on the head of some unlucky pedestrian. Concrete, combined with iron, will serve for both flat or high-pitched roofs, and the numerous crevices made by slated and plumbered roofs will then give place to an unbroken surface of asphalte on a foundation of cement, or lime concrete. Lime, besides, is an antiseptic, and possesses an affinity for oxygen, in contact with which, wood, iron, or other material, are generally in good keeping.

VII. WATER SUPPLY.

HEAVEN distils pure water, as it may be said man has sought out many inventions for making it impure by drawing it into varied contrivances, or from sources feculented by an injudicious position, material, or construction. "Moses of old, while laying down his laws dealt with the proplyactic as better than the therapeutic; his exertions in this respect were mainly directed to the preventive part, that when any foreign noxious substance suddenly appeared, his force was directed in as speedily making it disappear," or burying it deep down in the soil, where it would be deodorised and assimilated. There is no reason to doubt he was also well acquainted with the power of fire, not only as a disinfectant and destroyer of noxious substances, but also as a preventative in the reproduction of disease.

The quality and purity of the water supply is determined by the air, the earth, or filter bed, the nature of its conduits, and the cleanly or uncleanly character of the place in which, or of the inhabitants near to which, it may be stored. Filtering mediums are applied in many instances with beneficial results; but without cleanliness, and frequent change, they tend only to make that water which is already partially impure, more impure. At the same time chalk, carbon, or asbestos, are not despisable as middlemen collectors, or interceptors in the household for water impurities, provided they receive occasional purification.

Could a filtering medium be discovered of a composition incapable of becoming impure while it imparted a degree of softness to hard water, would it not be a sanitary boon, *pour negligence et paresse?*

It is well known in medical circles that water charged with lead detachments or corroded iron, predisposes the system of the individual in contact daily therewith to certain classes of disease; therefore, the material enclosing its conveyance cannot be too strictly guarded and watched. How frequently people of intelligence, as well as careless domestics, draw water from kitchen range corroded boilers for table and cooking purposes, when they should be at the trouble to use other more cleanly vessels, for obtaining hot water.

Although the detachment of lead, by the friction of water moving through lead pipes, may be infinitesimal, the greater poison, it is feared, will be found to be communicated to it from other enclosed, or open contact, which may be either external, or internal to the house; yet under certain conditions of lead, or iron, and the nature of the water acting on them, chemical change takes place, by which poison has been conveyed, and is being daily conveyed to mankind by water in contact with rotten material. For the perfect conveyance of water from any source, a material absolutely free from suspicious ingredients has yet to be composed, and the *Gignere* of the future who is able to discover a substitute for lead or iron, with a clean smooth surface equal to glasseous contact, will do as much for humanity and sanitary reform as Watt did with steam for horseanity and travelling reform.

In the country, people are as liable to be poisoned by water obtained from the midst of impure surroundings as their more or less favoured town neighbours, who get it from pipes and cisterns. In the country, many water supplies have to contend with streams, or wells reached by midden-steads, cesspools, and many other surface impurities, or where carelessness and uncleanly habits lend their whole assistance to its pollution. Who knows the poisonous germs that lurk in milk, for instance, communicated to dairy utensils washed by impure water, or absorbed by the milk from an unwholesome, confined atmosphere, or dirtyness, in which it may be in contact, or carried to it by some attendant on the sick, who may, at the same time, be the one who manages the dairy and milks the cow? To make matters worse, the cow may be labouring under disease. Milk is oftentimes closely related to water, especially when too much of the latter is added to it; yet no man knows what impurities are conveyed to him, from sources nigh or remote, or even lie bottled up in his wine cellar, made by water from sources more or less sullied, which he cannot help drinking.

Speaking of lead poisoning by water through lead pipes, Dr. Muspratt says, "The first stages of slow poisoning are very frequent, and well known to most of the general medical practitioners in every large town, as well as in the rural districts. The source is almost invariably found to be the water employed for domestic purposes, the lengthened use of which causes a depression of spirits, emaciation, and, finally, colic and paralysis. Several cases of this description have come under notice, wherein whole families were affected."

Dr. Richardson also says, "Contamination of water, both hard and soft, impure and pure, by lead is, in all parts of the kingdom, and under every variety of circumstances, the cause or sources of various obscure diseases of man (and also, doubtless, of the lower animals), of the nature especially of dyspepsia and colic. This proposition was abundantly proved by cases of minor diseases induced by lead contamination of various of the hard or impure waters of London."

In the majority of houses, or homes, it is found that water cisterns, or storages, are usually unventilated, uncovered, and inaccessible, in which case the house water supply generally occupies the darkest, obscurest place. These lead-lined, dirt-glutted receptacles can almost neither be cleaned, inspected, nor repaired, where the water receives fetid vapours from the house, and absorbs poisonous ingredients, not only from its own environment, but also from some foul drain with which its overflow is in communication.

It is not uncommon, in tenemental flats, to find a cistern of a lower house immediately below the space occupied by a water closet of the house above, the intervening floor substance being no barrier to occasional leakage—from the water closet apparatus—entering the water of the cistern below. The overflow of any house cistern should, in no case, be connected with a sealed drain, but carried direct to the open air, discharged over the slates, in an open space, or over the eaves conductor. In too many instances, water for domestic use is actually drawn from the same cistern as supplies a water-closet; besides, there is the risk of some ignorant tradesman making matters worse by connecting its overflow with some foul drain, and its water becoming impure by stagnation and other means. Considering these risks, the supply for domestic purposes can surely, in all cases, be drawn direct off the main pipe, the freshest source before the water enters the cistern. At the same time, a reserve supply from a cistern is also necessary, when repairs, or temporary stoppage, of the main supply, takes place, that these emergencies will not render the household waterless. Materials containing lead glazing, or liable to corrosive action, are, therefore, to be avoided for cisterns, and, in their place, such materials, on which water has no apparent action, are to be sought, and a cleanly material found for the storage of household water in enamelled or galvanised iron, salt glazed earthenware, or glazed tile lining.

The main service pipe, on entering the house, should be provided with a coupling for attaching a hose in the event of fire occurring, which would also serve as a stopper for turning off the "main supply" in the case of repairs, on which could also be engrafted a secondary crane for emptying all the pipes between this point and the cistern, in the event of frost or accident affecting any of these pipes. In large houses, the cistern might always, with advantage, have a valve-stopper at a main trunk for intercepting the supply it furnishes; off which trunk, the supplies of bath, basin, water-closet, &c., would be drawn —all liable to be shut off by the valve of this trunk for repairs, or accident, without emptying the cistern of its contents, which invariably must be drained ere the mendings can be accomplished. The water supply from the cistern to a high-pressure boiler must always be constant, incapable of being interrupted by any person in the house, as any temporary stoppage of this supply to the boiler, to be again suddenly turned on the red-hot, or over-heated boiler, would induce an losion endangering the lives of the inmates, besides running the risk of melting the conduit pipes proximately connected with the boiler and fire. Any crane used for obstructing the water supply to the high-pressure boiler must be placed for the use only of workmen during repairs, and so long as the water cessates, the fire against the boiler (usually in the kitchen) must also cease.

As explosive conditions always lurk in high-pressure boilers, it is not unimportant that such have sentinels attached, in due form of water-gauges and steam warning-valves, so situated as to be always in sight and hearing of an inmate. Water supply pipes, in travelling through the house or elsewhere, should be laid in positions affording an equality of temperature all the year round; and where this temperature cannot always be obtained in exposed places, a protection from frost bursts can be given by wrapping them with asbestos, felt, or paper. It is utterly imprudent to convey water pipes over or along principal parts of the house, as it is important that, wherever placed, their traversions are accessible for inspection or repairs. When any accident or leakage does take place, tearing up and partial destruction of their surroundings in searching out concealments would be thus avoided.

How much ill-temper, discomfort, and expense would be saved to a proprietor, or his tenant, were righteous pipes and their concomitants always found enveloped in their proper position? Sinks, basins, baths, tubs, water-closets, &c., would rush into order, and assume their true place, with hinged or portable accesses, exposing all their parts, and all pipes would become reachable. In the event of any temporary derangement of the water-pipe system in connection with these conveniences, much destruction to more of the pipes than the actual branch containing the error, and loss of time in repairing accidents by the primary application of substantial movable coupled unions to certain pipe-junctions and branches, would be foreseen and saved. In the case of elaborate water-fittings and hot water complications, and, indeed, wherever practicable, spaces are necessary for the admission behind the *scenes* of an inspector or a repairing tradesman, without which these elaborations are always difficult of access, and their enclosures liable to damage at each occurrence necessitating their being laid bare. It should be mentioned that when gas is used for heating a bath, it too seldom occurs to the householder or his plumber to provide a channel for conveying away from the apartment the products of combustion. Such an outlet would also serve as an additional ventilator of the apartment.

Speaking of water-couplings, lead is so pliable in its nature that plumbermen and jerrymen recognise in it a material, workable with or without these brass or copper attachments; besides, it readily adapts itself to any class of work or form of "*practice*," and is still *lead*, although its operator saves a pound or two of material per square foot when applied to soil pipes, or roof coverings. However light lead services are introduced from cisterns which have little pressure, their lightness may not be so readily detected as when applied to sources of higher pressure, where the latter sooner detects any weakness when too much saving has taken place. In some districts of country, where ground-water is scarce and hard, the conservation of rain-water becomes almost a necessity, but on economical grounds soon repays the expense of storage in labour, soap, and tear and wear in that important operation of the washing of clothes, which may be less seldom indulged in when water is hard. Space for the storage of rain-water may be smoothly formed with glazed brick jointed with cement. A space made 6 feet square, and 4½ feet deep, will safely hold 1000 gallons, affording a supply of 10 gallons daily for something like three months. A roof containing 180 square yards, with a rainfall of 2 inches in 6 hours, will probably yield 120 gallons.

hen the temperature of the water in summer is sed, or when it comes from sources liable to be gnated with impurities from the house or other storages, the boiling of all drinking water is a prudent precaution, as heat is effectual in destroying organic substances, and as rendering the water innocuous. It has been noticed by Dr. Latham that the inhabitants of certain districts, obtaining their water from ground wells, were zymotically affected with the increased temperature of the water after a dry period. The water having been considerably lowered by drought, it, of course, gradually raised itself after rainfall set in. While so rising, the earth imparted its interval acquirement, in the form of latent heat, decayed and fermented matter. Gauges having been set, soundings were obtained of its temperature and level, enabling Dr. Latham to predict the epidemic that would eventually follow its use, after reaching a certain temperature and level. Like Noah, the wise prophet of old, who warned the people that, unless they made provision against a flood, it would surely come upon their peculiar localisation—they would certainly be drowned—so did Dr. Latham, in our own day, predict after this dry period, warning the people that, unless they *boiled* and *filtered* the rising water, disease would undoubtedly overtake them, and, although the authorities of the district obeyed and placarded his prophecy, he was, nevertheless, scouted and unheeded by the majority until typhoid, diarrhœa, and other allied diseases broke out within a short time of the rising tide.

WATER SUPPLY.—For domestic purposes water should be "(1) at all seasons clear, transparent, bright, and, when seen in large bulk, pure blue, that being the natural colour of uncontaminated water; (2) well ærated, holding in solution from 7 to 8 cubic inches of air per gallon, consisting of two or more cubic inches of oxygen, and six of nitrogen; (3) it should have at its source a uniform temperature equal to the average of the climate for the year, which, in this country, varies but little from 50 deg. Fahrenheit; (4) it should be free from living organisms, vegetable and animal, and from all dead decomposing organic matter, and should not dissolve lead; (5) it should hold only a moderate quantity of mineral matter in solution, and thus be soft, and not deposit a coating of lime or magnesia when being boiled."

VIII. TREES AS SANITARY AGENTS.

SOME trees and shrubs, experimented on, whose roots had been put in communication with the moist air of sewers, were noticed to grow rapidly, clothing themselves more luxuriously than their neighbours not so highly favoured. A like result also happened with some plants exposed to sewer air.

Were large distant areas for town sewage planted with timber, the tree cultivation and irrigation would, no doubt, be less profitable than cropping, but, on the other hand, would be attended with less labour. In laying out such areas, hard woods, sturdy oaks, and Scotch firs would take exposed situations, backed up by poplars, lime, &c., while the finer qualities of pines and shrubs would nurse themselves in the centre, or in more sheltered positions. For extremely exposed situations, the plain tree takes such a firm spreading grip of the ground that it can scarcely be blown down, and, thus, is well adapted for bounding nurseries, plantations, or forests. The poplar, willow, alder, dogwood, and lime, are all rapid growers, and large drainers of wet or saturated ground, while the pine, as a sanitary agent, in rendering the air of damp, marshy, or sewage-saturated ground wholesome, cannot be surpassed.

In the cultivation of larch, its durable qualities would render it useful as a timber for building, and many other purposes; then *poplar* is becoming every day more *popular* and valuable for "bent ware, such as barrel-hoops, pails, ship-masts, and cabinet work;" while the other families of pine and hard wood varieties find outlets connected with the dwelling, the vehicle, and the farm; while the willow, alder, and dogwood, or their substitute, will supply gunpowder until the nations learn the art of settling their disputes by arbitration.

However praiseworthy grass or other crop-rearing by irrigation may be, it has to be remembered that ground becomes sooner soured, and its crop invalidated, by over-saturation in certain soils, than were the same soils under trees; yet, it is remarkable how little, if anything, has been done by utilising sewage for the cultivation of home timber. By conveying sewage to large tree-filtering areas, instead of losing it upon the waters, poisoning fishes, and glutting streams, to return upon the shores, the vegetable kingdom would contrive gratefully to absorb and thrive on its manurial properties, while robbing the air of any noxious effluvia arising from the saturated ground.

The present Generation can only conceive of rural groves, and pine trees "waving high"; but if they can exert their force in conserving such sylvan delights—if only for man's physical and mental recreation, apart from any pecuniary value, or the worth to be returned by forests for value received—what would be the benefit to Adam's sons and daughters? Would not the waste substances of humanity, present and future, parts of themselves, be built up in the form of trees occupying rural spots? Would not these trees, in the sanitary value they possessed, and the pleasure they yielded, be objects of beauty for the jaded body, and sense, and mind of the people—objects to which the parents of mankind have contributed—to be always refreshed, multiplied, and renewed by their offspring?

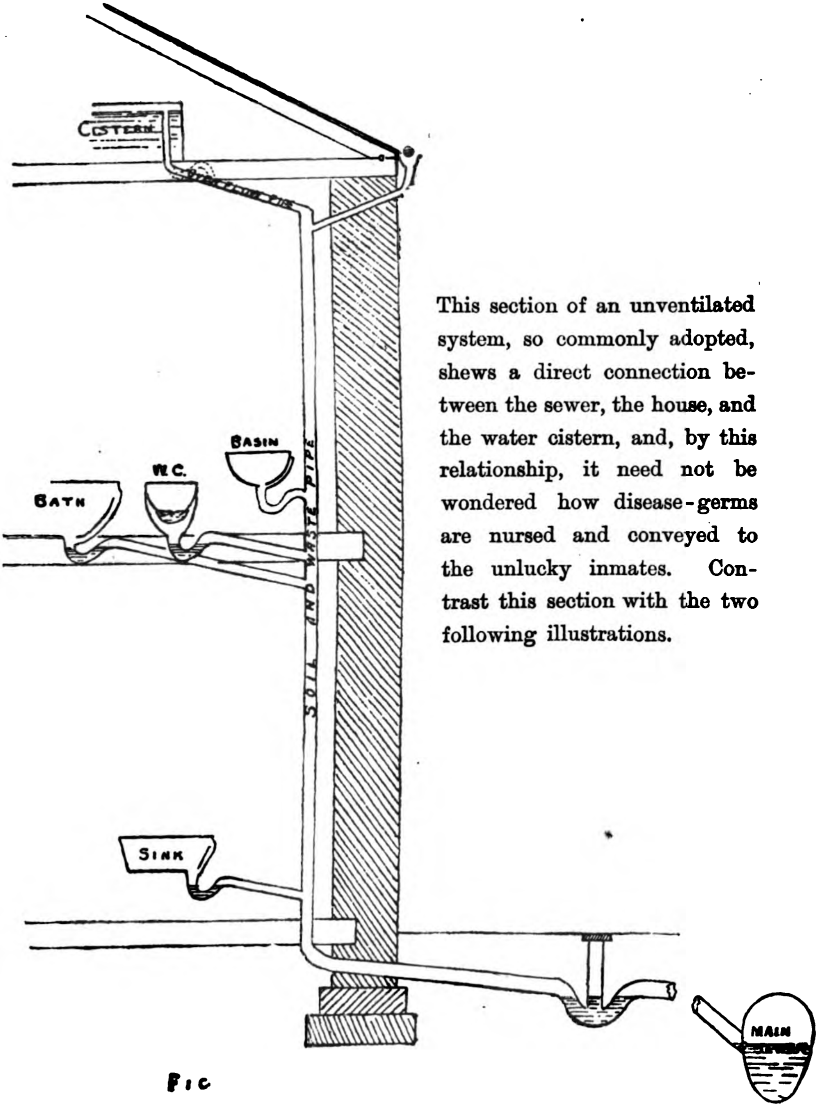
IX. DRAINAGE.

"THAT people must make use of their own property in such a manner as not to injure that of others," is one of those principles on which individual and premisial sanitation is based—in others words, "doing unto others as ye

would that others would do unto you." If a cesspool, or dung pit, be constructed in such a manner on a person's own property, whereby impurities percolate or pollute that of a neighbour's, the good old rule is infringed. On the same condition, a person is not entitled to issue from his property chemical vapours, noxious to his neighbour's lungs, destructive to his crops, or injurious to his cattle; nor is he justified, however politely, in conveying from his property to any public or private water-course poisonous ingredients, whereby the public or private fishes of the stream, or his neighbours' amenity, will be injured. In this respect, public hygiene will always be more or less influenced, and dependent for good or evil, upon private and individual cleanliness, enterprise, and regard for one's own, as well as for a neighbour's, property. The sanitary condition of every house is affected by the manner in which public sewers are attached to house-drains, drains from the ground of basements, drains from the ground of the house surroundings, and drains from rain-water conductor pipes; by the position and mode of laying house-drains and internal soil-pipes; by the amount of air, and mode of ventilation introduced within these drains, as much as by the character and situation of the Convenience with which the concealed drains are in communication. In a report of sanitary inspections in Glasgow, it is stated that out of 300 houses visited, only fifteen just ones could be found, shewing that only five per cent. of the houses so visited could be said to be correct and sanitarily drained. Regarding the death-rate analysis on crowded and less crowded areas, the mortality reaches 40 to 50 per 1000 per annum living in overcrowded regions, while the sickness is estimated at 15 cases for each death; whereas, where improved house
tion and purer surroundings are inhabited, the
rate is visibly reduced to 14 or 16 per 1000, and
ss in a ratio equally proportionate. If 15 different
ies, according to Dr. Richardson, are capable of

being conveyed by sewer gas, the principle, position, and condition of drains in relation to the house, possess a power not less than over-crowding for the production of disease and premature death. It is a moderate estimate to state that not one-half of the dwellings of all classes are free from drainage defects; these defects, by their foul gaseous emanations, involve certain loss of energy and health to the occupants, besides the pecuniary loss inevitable from preventible disease. This loss over the kingdom from preventible disease is given at "25 millions annually, or three times the amount of the poor rates."

It is well known that lead or iron, used internally for carrying away sewage, unless ventilated, soon decays and becomes indented with numerous holes, through the action of their confined gaseous air, detectable by the microscope on pipes that have been only a short time in use, and perceptible to the naked eye on pipes that have been longer in use. These internal pipes are in direct communication with the house-drains and sewers, on which the greater heat of the house acts as a continual sucker, while the confined sewer air, pressing for liberation, seeks the most attractive outlet within the dwelling. There are many ways sewer air may obtain admission to the house besides unventilated connected attachments. It may be conveyed to the interior of the roof or garret by the closed attachment of rain-water conductor pipes; from ground-drains below, or drains in the ground outside immediately surrounding the house by ground-air, as much as by the soil-pipes or drains from the premisial conveniences. The prevailing idea of the past—which is not yet obliterated—was that a water-locked ∽ bend or trap, put on the drain or soil-pipe, makes the sewer keep its gases to itself; whereas the already-confined sewer is only made more confined for liberating its gases in the house. The more traps put on drains, the more hindrances they are against easy flow and rapid removal of the sewage, forming gathering spaces for waste matter, tea leaves, etc., which absorb and retain the sewage. Traps on soil-pipes and drains, however, have a place in directing the circulation of the fresh air within these channels; but the traps, as well as the soil-pipes and drains, should have cleansing and inspection taps, and means for ventilation and copious water flushing. When traps are applied inside the house, their object is, mainly, while fresh air is flowing within the house soil-pipes, to assist the air circulation within their limits, independent of the air of the house, as their object is outside to make the air circulating in the house-drains independent of the air circulating in the street sewers. In trapping a drain outside, between the common sewer and the house-drain or soil-pipe, the inner opening of the trap must have an air space open to daylight, so as to produce disconnection between the sewer and the house-drain. This opening has a diaphragm, dipping into the water of the trap's sunk bend, so that the sewer, on its side, can be ventilated, or its air carried to any height above all windows, while the house or other drains are admitted on the inner side next the building, in a space open to the atmosphere, the former having a covered lid, the latter a tolerable-sized portable grating, both giving access, on each side of the water-locked division, for inspection or cleaning of the drain on its either side. By allowing an abundant supply of fresh air to circulate in all house-drains; by making a complete disconnection between these drains and the street sewers, and extending the same principle to all public sewers, what would be the result? Would not a rapid motion of nature's disinfectant, the atmosphere, contrive a state of diluted innocence for the air of these channels, while it arrested gaseous generation due to confinement, or rendered harmless, vapours which become poisonous when confined and left to themselves? As impurities are liable to adhere to the internal surfaces of all drains and soil-pipes, a sufficient water-flush and interval scour also cannot be denied them. In attaching ventilators to traps or soil-pipes, whether carried through walls, or in the form of

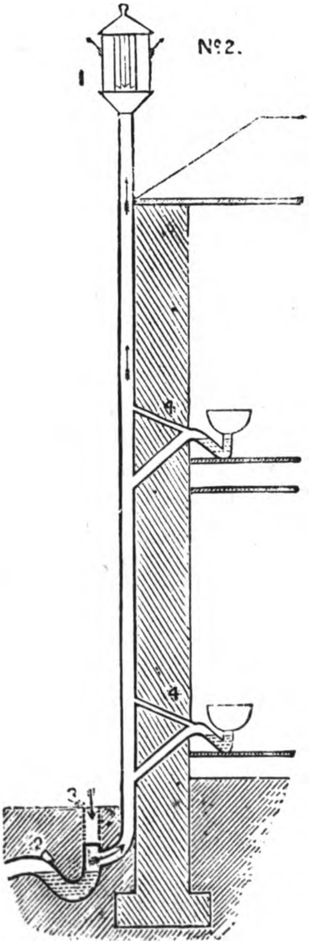


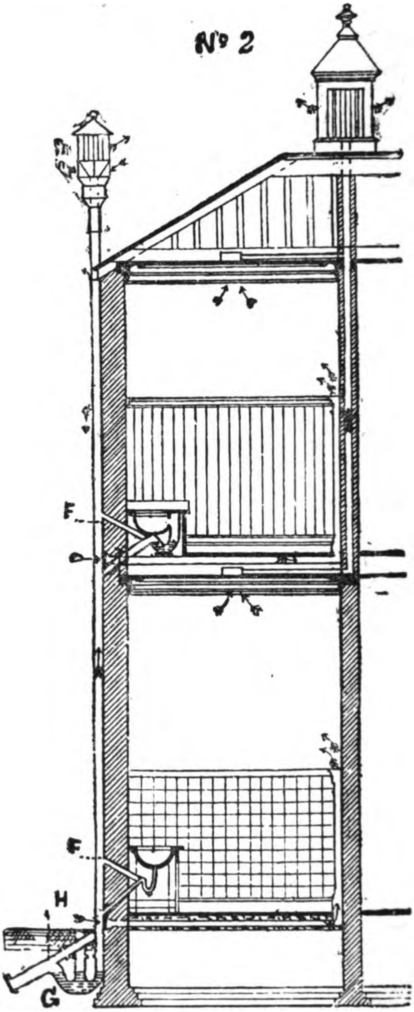
This section of an unventilated system, so commonly adopted, shews a direct connection between the sewer, the house, and the water cistern, and, by this relationship, it need not be wondered how disease-germs are nursed and conveyed to the unlucky inmates. Contrast this section with the two following illustrations.

Fig.

Section of the Unventilated System of House-Drains or Soil-Pipes.

shafts carried up to suit each special requirement, these attachments generally should possess a calibre equal to





the channels they ventilate. It should be an inducement to ventilate all iron or lead soil-pipes, on account of the preserving power of fresh air for these materials, or, rather, for its destructive power on confined gases, which feed on these materials.

It may not be unnecessary to repeat that, if there is no connection allowed between the air circulating in the house soil-pipes and the sewers outside, or between either and the house air inside, and so long as these conditions act their several parts automatically, permanently, and perfectly, the entrance of sewer-air to the dwelling must for ever—hark!—be considered an impossibility.

Figures No. 2 show BOYLE'S system of ventilation for drains, house soil-pipes, and sewers. The ventilators being acted on by the atmosphere, an upward complete current is established and maintained, by which these channels are exhausted, and kept perfectly pure, by fresh air entering and passing out at a high level clear of all windows.

The following gradients, taken from the *Building News*, are given for circular pipes running half-full to produce self-cleansing velocities:—

A	4-inch	pipe	requires	1	foot	in	40.
„	6	„	„	1	„		60.
„	9	„	„	1	„		90.
„	12	„	„	1	„		200.
„	15	„	„	1	„		250.
„	18	„	„	1	„		300.
„	36	„	„	1	„		600.
„	48	„	„	1	„		800.

Generally speaking, a small pipe requires more fall than a large one, and should never have less fall than 1 foot in 30 for a 3 or 4 inch pipe; or 1 foot in 60 for a 6 to 9 inch pipe. The 6-inch pipe, with a fall of 1 inch in 60, will give a velocity of 250 feet per minute running half-full.

Drains built with common brick unglazed, or common stone, are the worst form of channels devisable for the easy and rapid conveyance of sewage—their roughness and imperfectness continually interrupt its course, besides leading their contents to the surrounding ground, ever ready to be caught by the ground-air, and carried to the interior of the domicile.

Pipe drains, again, unless their joints are smooth, perfect, and close united, also offer hindrances to the sewage flow; as occurs when these pipes are put together with broken joints, or imperfectly united. In this way, sewage is conveyed to the ground immediately surrounding the premises: obstructions also accumulate at these junctions, which ultimately choke the drain. From this cause, it is easily seen how the ground outside, or basement below the building, becomes permeated with a mass of filth, going on sometimes for years, until the persistent bad smells, and ill-health of the inmates arouse suspicion—ere the secret of their illness is divulged. But, by the act of the careless or ignorant labourer left to himself, the jerry-builder, odious plumber, absent superintendent, or architect more taken up with his "elevation," the inhabitants have suffered, and probably will permanently suffer.

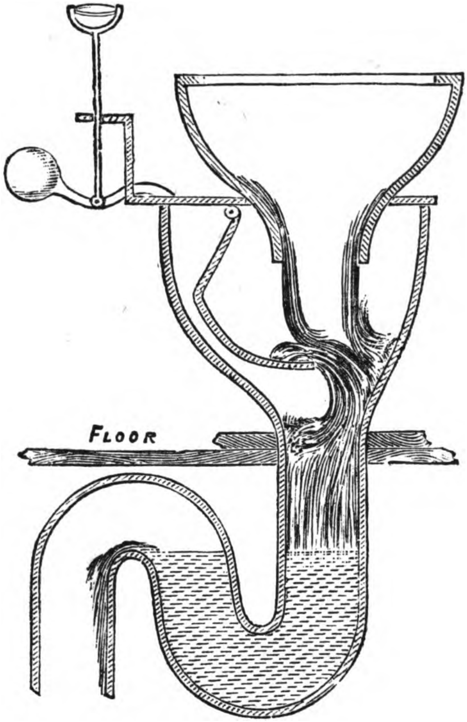
When substantial sewering is required in ground liable to sink, the pipes are laid on a road of concrete, enveloping their lower half, which tends to prevent their being fractured at the joints, by either the sinking of the ground below them or by the weight of the earth above them.

A well-laid drain-pipe cannot lie solid, unless it has a level sole, or, at least, shoes here and there, flush, or even, with the ordinary projecting faucet or flange. For the general mind, it is as well to explain, that the faucet or flange round the end of each pipe, is simply a widening of the mouth of one pipe for the admission of its neighbour, that the internal union of both pipes, when laid, will have an even surface. By this plan of horizontal jointing, commonly adopted, there is no means of the workman seeing the correctness of their internal surface union, after the pipe is home, or partially home. In this manner the joint so made may, or it may not, be close, and fit even, or the cement used round the junction may protrude round the union, to afterwards cause obstruction to the flow of the sewage. But an inspection coupling may be obtained in a different formation of joint and mode of jointing—that is, in providing each junction with a portable bridge extending half round the upper part thereof, and covering both pipes. In this way the pipes would fall vertically home, the union would be seen, and the cement used would be smoothly, and evenly dressed off to the line of the flow, after which, the movable bridge, by being properly, portably, or permanently fixed in its recess, the union would become as strong, if not stronger, than the usual blind junction.

Iron has been strongly recommended by some theorists as a material for sewering, and although its use may be necessary in special cases demanding strength, yet, for general house drainage, it is fearfully corrosive, liable thereby to become obstructive to the easy flow of the sewage, besides, being more expensive and uncleanly than glazed clay ware, and unless it can be made to possess, and maintain a smooth bore, equal to glazed clay pipes, cannot be favourably entertained.

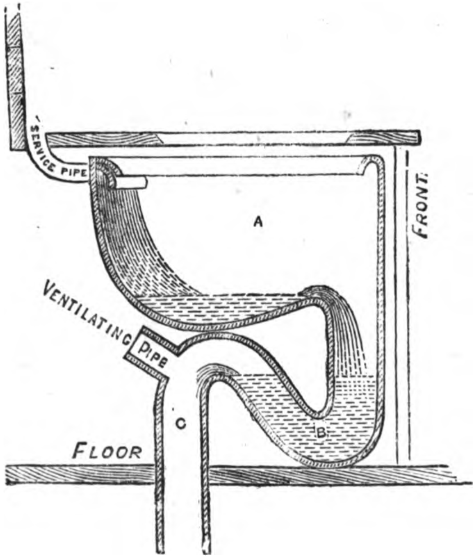
Were the position of house drains always marked, especially when taking unexpected turns, provided with suitable access inspection, and cleansing openings, for future obstructions, or, were they all indicated with sized-depths on a plan, this plan filed for reference, kept by some AUTHORISED OFFICIAL, whose duty would be to register all new, old, or altered premisial drains from time to time, would not these hidden arteries be more under private and public control, and less likely to become dangerous to health?

It is not enough that drains and soil pipes be left in a correct state, but they must also be maintained in that condition, and regularly tested, at least once a year; those under construction, or repair, inspected during these operations, and each dwelling registered and certified as otherwise sanitarily fit for occupancy. As occupants, or intended occupants, are generally unlearned regarding sanitary details, they should have some competent guarantee that their house, or intended house, possesses a degree of sanitary order, made aware of any disorder, that such may be rectified in time, ere disease by it has been conveyed to its present or intended inmates. There is an asphyxiator or machine shewn in the Appendix, by which the drains or soil-pipes can be tested by smoke. This machine is manufactured by Messrs. John Watts & Co., of Broad Weir Works, Bristol, at such a moderate cost that no ordinary household need be without such a drain-tester. A machine of this kind has a double value, by which householders, in acquiring its use, are led to be interested in the details and whereabouts of their house-drains, while teaching themselves in the detection of flaws and leakages. This machine is also applicable for the disinfection of rooms, clothes, and bedding. Although architects are not blameless in the position they accord to house conveniences and their pipes, besides many other evil placements, the greater part of jerry work, when investigated, will be found to have taken place where virtually no architect had been employed—where houses have been speculatively erected, not with any view of after economy or sanitary acquirement, but solely, however illegitimate, for avarice. Certain classes, who are penny wise and pound foolish, care not to pay for sanitary intelligence in the erection or occupation of their houses, but reduce economy to its lowest itinerant denomination. They build in haste, *minus* an architect or his fee, by which they do not always get a cheaper article, but everlasting confused torture, and future reduced value to the bargain, which usually proceeds from an article ill-considered and undesigned. The water-closets are generally placed in the very heart of tenemental houses, and if these water-closets are at all ventilated or lighted, it is only into a fusty common staircase, augmenting that promiscuous fustiness already contributed by the other ouses. The staircase is thus a receptacle for foul vapours, ready to return again to the dwelling interiors, and which all persons must imbibe as they pass to and from the domiciles. The soil-pipes attached to the conveniences so placed are also within the centre of the tenements, where pipes are more or less leaking, rotten, or unventilated. Added to the already unventilated apartments and musty staircase, it need not be wondered how families are preyed upon by noxious germs subsisting between their abode and the interior drain world. Conveniences requiring soil-pipes, if they cannot always be placed outside of the dwelling altogether, or in offshoots from the house, should at least be placed against outer walls, so that the drain-channels travel the



The Complicated, Unventilated Pan-form of Closet.

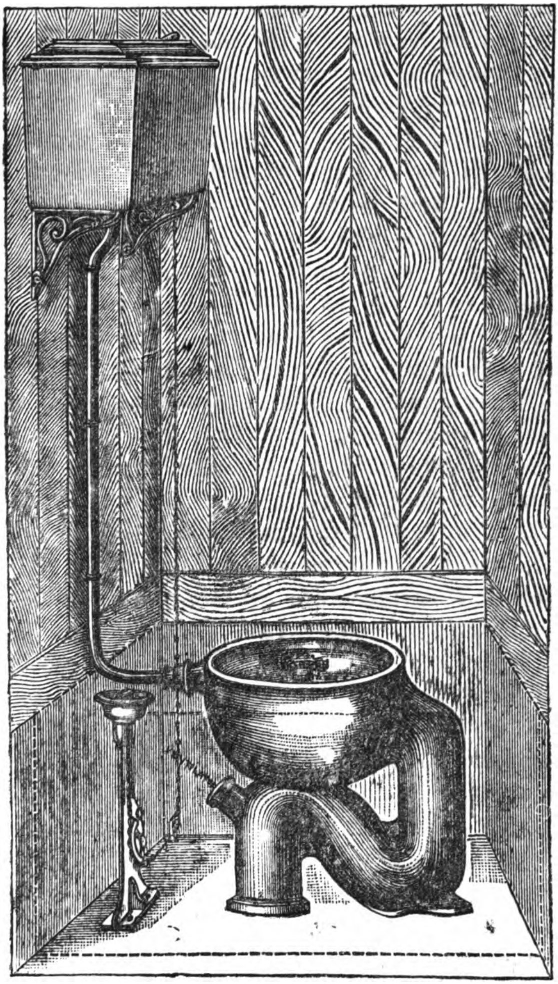
shortest distance in reaching the outside. When these conveniences are placed in the middle or principal part of the house, or over a good room (if a large house), or wash-basins in bedrooms or places off bedrooms, there is always the risk of damage to the better part of the premises from leakage or accident. Besides the unwholesomeness, they are liable to ooze to the house interior or proximate apartment. It is expected that all house soil-pipes, where practicable, are placed outside the walls of the premises, where they can be seen, where no sewage can lodge within the house, and where they are most accessible to, and rendered innocuous by, the air of heaven.



The Improved Glazed Earthenware Closet.

Neither should drains pass below any part of the house, but this is not always practicable, as they are obliged, in reaching the street, to pass through a "close" or "passage;" but they need not always be without ventilated openings before, and after, so passing the building.

Regarding the many devices afloat for water-closets, those with elaborate mechanism or complicated crank and pan attachments, in their liability to disorder, and odorous propensities arising from corroded iron, and parts unreachable, are householders' grievances. The philosophy and felicity, therefore, of a good mechanism must lie in its



simplicity, now obtained in a basin and ventilated cesspool or bend, in one or two pieces of earthenware, having a direct action and water-flush through a 1¼-inch or 1½-inch pipe from the cistern, operated by a "slide" or "pull-down," applied to the side of the wall. The action can also be applied to the seat in the usual way, but is less complicated when applied to the wall-side.

The "National Closet," shewn in the Appendix, as manufactured by Messrs. Thomas Twyford, of Hanley, Staffordshire, and William B. Morrison, 400 Eglinton Street, Glasgow, must be recommended as having all the requirements of a sanitary closet. The simplicity in fitting up such an excellent closet is seen in the immediately preceding illustration. A simple waste-not flushing cistern (see Appendix) is made by Messrs. Winn & Co., brass founders and manufacturers of sanitary appliances, Birmingham. It has no complication to wear or become disordered, which is suitable for application to the before-described closet.

All kinds of ventilated drain-traps, etc., are supplied by Mr. John Dodd, sanitary engineer, Liverpool.

Enamelled earthenware washing-tubs, sinks, glazed bricks and wall-tile linings (see Appendix) are made by Messrs. Brown & Son, Ferguslee, Paisley, the use of which, for cleanliness and health, cannot be over-estimated.

Safes are usually put below water-closets, baths, basins, etc., intended to catch water leakage, or leakage from sudden rupture of any part of the apparatus and pipes. These safes should not be drained into a hidden soil-pipe, as they sometimes are, but carried direct to the open air, where they will be seen, serving as watchmen or indicators of the fissure, instead of secreting that leakage in a confined drain, and running the risk of thereby conveying its air to the apartment.

THE PERFECTION of house drains is surely not unattainable, if only honest pipes are laid by careful, telligent, honest men, which means pipes highly glazed (they cannot be too smooth), in a declivitous position, correctly jointed, with inspection openings, disconnected house attachments, and always capable of airing and cleansing themselves. The more open to the atmosphere all soil-pipes, drains, and sewers become, the fewer hindrances used on them, the more independently they air, wash, and disconnect themselves between the dwelling and their outlet, the more pure must they become for saving human life, instead of possessing a confined, dirtier state, ever ready to attack and destroy it.

X. EARTH-CLOSETS.

At a moderate valuation, the excretions per head of the population may be taken at ten shillings per annum, the material proportion being 1 cubic foot of fæces and 9 cubic feet of urine, equal to 10 cubic feet for both. By drying, the fæces is reduced to a fourth and urine to a twenty-fifth part solid material of their original bulk. A fire produces about 52 cubic feet of fine ash per annum, which ash will absorb a third of the urine per head. Each house, with an average of 5½ persons, where a dry earth-closet system is adopted, requires 52 cwts. of dry material to be supplied, increasable by augmented occupants, and decreasable by the extra fires in use. It has been remarked "that clayey or loamy earth, and more particularly the brick earth of the drift formation, is the best for the purpose."

According to analysis of wheat crop made for the Royal Agricultural Society, that raised by human guano produced two-thirds more gluten than wheat raised on the same land by ordinary manure. It is well known that land decreases in ultimate producing power when over-stimulated by foreign guano, and, unless nourished by food more substantial, that land soon becomes impoverished. When sewage is carried to the sea, it is, of course, lost, and land loses the benefit of that waste from home and foreign produce, which, sent to its soil, would not only enrich the tenant farmer, by putting him in a better position with the same labour expension to compete with his foreign brother, but the laird would also have his already over or under-lined pockets further bulged, and animals would have their stomachs distended, with, perhaps, cheaper and better home food. But this is not all. The money flowing away for foreign land-stimulants instead would float at home, and the land which is deep in debt, or rather the people, who are its debtors, would, in a degree, retrieve themselves from foreign bondage. It is needless to speak of the insanity of putting native guano into a river or stream passing through or near a town, and having dredgers plying continually for miles up and down that river, removing the glut further away to an extension of the stream. In saving this native guano, each village, town, or city must be governed by its own peculiar localization, as no one system can, of course, be expected to meet all individualities, although the principle of economics can so meet them. A city like Glasgow, for instance, would satisfy a farm of many thousand acres for the rearing of Crops and cultivation of Trees; and if the scheme did not redeem and maintain such a farm, and carriage thereto, by drainage, or other means within the range of ordinary financing, the land would, at all events, be a gainer, which it would ultimately gratefully return in produce. The city would, at least, have a cleaner water-way, be less expensive to keep clean when not used as a sewage carrier, and possess fewer disease-germs to be wafted backwards and forwards from sluggish, offensive matter, ever ready to settle upon any one so unlucky as to be predisposed to their reception. The following analysis shews the nature of sewage-water taken from the river Spree, related to Berlin as the Clyde is to Glasgow, or the Thames is to London:—"·061 of a cubic inch contained 10,000 germs capable of development; in the city the number was 950,000; below the city, 4,800,000; and at Charlottenburg, as many as 10,180,000." The natural admission of ground and surface water to a river is enough. All other matter should be conveyed as quickly away from the town as possible in other special channels, possessed, where tunnelled, with a rapid air movement, as oxygen, when in motion, more rapidly changes and destroys the danger from organic matter. Furnaces, if erected near some of these tunnels, would destroy street sweepings and disinfect matter, not advisable to remove for other modes of surface treatment; they could also be turned to account in creating movement in the tunnels by their heat, or their heat would transmit power to mechanism so to move the air in them, the energy of which would not be lost, but utilized in the production of light, the preparation of dried earth, and, although not necessarily in the meantime, for Cremating bodies and germs, if built and placed having this object in view. Of course, graveyards in the centre of towns are becoming every day more noxious and poisonous to the air for the living, and, unless planted spaces are obtained in the country far away from towns, with their special conveyance facilities, some other means than burial, such as cremation, may ultimately come to be adopted, or partially adopted, instead of using central areas, where their injurious effect on the living are pronounced. Disease germs from graveyards are not only wafted over the city by the wind above, but they are infiltrated to quarters by the ground air beneath. However complete towns can be sectionally arranged and supervised regarding household receptaclements, or in the removal of fæces during the night, and the supply of earth during the day, the dry-earth system in city densities cannot be thought of, although there is no reason that urbanities, areas less crowded, and sea-side retirements should not possess, improve, and revive these remnants of bygone hygiene. They may not be so fraught with convenience, or slothfulness, as water-closets, inside the dwellings, are; but the greater health accruing in their use outside—provided systematic cleanliness, dryness, and removal were adopted and maintained—would, at all events, repay for the extra trouble, or expense, if any, involved by them. Buildings structurally organized for either an earth system or a water one, if such restriction did no more than assist in perfecting positions for either system, the dwellings would, at least, not be losers by such an arrangement.

Families go to the sea-side from their city abodes to lay in a stock of health, probably impaired by the houses they have left; yet they procure lodgings probably in a much worse state regarding drainage than their city home. It occurs in this way: that most of the domiciles at the sea-side, as elsewhere, have unventilated house-drains attached to tide-fluctuating sewers, and the connection with the house is partially, if not wholly, sealed. On account, also, of the intermittent chokes produced by the flowing tides—by which the sewage returns to the shore and the gaseous air to the houses—these sea-side dwellings are thus, in many cases, badly drained, only they are more exposed to the atmosphere than the most of town houses, by which the air contained in them is more readily diluted; but poisonous ingredients, all the same, may be conveyed by night or by day to the inmates. It may be explained that, as "the air in sewers is elastic, the flow of the tide upon the house-drains or sewers compresses that air, temporarily stops their action, so that the gas is actually forced back upon the shore and into the houses;" and if the drains are unventilated, and possess no external openings for the outlet of the sewer air, additional poisonous air is manufactured and whiffed into the dwellings as compression increases. Again, when the houses are improperly drained into a cesspool, or unventilated, air is also bottled up for an attack upon the house interior, or there may be a well not far distant into which the cesspool contributes some of its substances, or a cistern is connected with a tide-locked drain, all of which must be looked upon with suspicion. Pig-styes and privies, unless constructed in a proper manner and occupying a prudent position, are as liable to contaminate *well-water*, often too near, or communicated from them by the ground-water and ground air. To prevent this, the floors of the midden-stead, pig-stye, privy, and cesspit attachments should be laid and the cesspits surrounded with impervious cement-concrete, or asphalte, the cesspits acting as receptacles for draining the floors of the privy or stye. It is necessary that the privy seat-pit be kept dry and free from rain-water, as this ingress causes a smell, and interferes with the action of the dry earth. Each cesspit for a family of 5½ persons should hold, probably, 15 to 20 cubic feet, or a quarter's storage material for a rural district, decreasing for monthly, weekly, or daily storage, to meet the requirements of sea-side, urban, or other areas. After cleaning out the cesspits, they should be provided with a thick layer of the absorbent. The liquid cesspit, if covered over as it should be, must be provided with an egress and ingress of air, the seat-pit ventilated independent of the little apartment, and the latter also ventilated by a current of air getting in below and passing out at the highest point. Portable earth-closets are made to suit any position by the Sanitary Company of 95 Bothwell Street, Glasgow. They act mechanically with their use, in shovelling a requisite quantity of dried earth from a storage-receptacle placed behind and above the seat, the front below the seat being hinged for access to its space where it is occupied by a movable pail. For the obtaining of fine ash for ordinary privies, each house or privy should have a cinder-sifter of 3-16-inch mesh belonging to the house, if a common privy; if a private one, it should be attached to the seat-pit, by which all cinders would be obtained for fire-backing, in economising fuel and retention of heat, while the finer ash would fall into a storage ready to augment and mix with the dry earth.

In the majority of instances, the privy is kept in an unclean, uncomfortable condition, always of a lean-to shape, as if its architecture had been fixed by the *unalterable decrees of fate*, or by the want of human ingenuity, and what is surely remediable in more neatness and artistic treatment by more cunning workmanship. The privy should not be looked down upon as an insignificant commode, but should rather be elevated and improved, if only for the conveyance of pleasurable beauty for all who use or see it. Every person must admit that, in its present sanitary aspect, it is not only very far from what it ought to be, but also very far from the utmost practicable, or even from a permanently tolerable degree of cleanliness, comfortableness, and neatness. The advantage of the earth system, where it can be adopted, is that it can be readily applied to land as a solid. In dealing with sewage, land obtainable from the lords of the soil for irrigation is not always an impossibility, neither the erection of large sectional filtering beds, or where nature has provided ground for crop or tree cultivation. In any case, more uniformity of government is necessary between city, urban, and rural authorities, without which outlying districts are discouraged from taking any general or partial interest or burden for the cleanliness of their own dominion, or the cleanliness of the river into which they drain themselves, by which their neighbours' amenity, opposite or further down, becomes impaired.

XI. VENTILATION.

It is no exaggerated estimate, that not less than a quarter of a million in Britain alone yearly succumb by breathing impure air, obtained from close apartments, workshops, and other sources.

Do not hundreds of thousands, with pallor-stricken countenances, affected by depression, headache, loss of appetite, etc., speak of breathing contaminated air? Is not suffering, or loss of energy, to individuals smitten by unventilated homes or workshops, a pecuniary and physical loss to themselves and the nation? Does not an unventilated workshop, while producing this physical loss on the employee, reflect a pecuniary loss upon the employer? If an employer of labour wishes substantial workmanship, and a fair day's labour for a fair day's wage, from his employees, confined in a workshop or factory, their strength must not be curtailed by an unventilated atmosphere, but should rather be added to, in the supply of a due proportion of fresh air. Indeed, it is found that short hours, with a copiousness of fresh air at all seasons (but flavoured with heat in winter), will not only be more economical for the employer, but will produce more and better work than longer hours with imperfect ventilation. Nor can the schoolmaster or his pupils, nor the speaker or his audience, act their "silvern or golden" parts in a manner mutually cheerful, if subjected to a deleterious atmosphere.

"Were a reduction of the death-rate of 5 per 1000 per annum made, by sanitation, there would be a saving effected, out of four millions of a population (equal to Scotland), of twenty thousand lives annually, and a saving in money, for excessive funerals and for labour lost to the adults by excessive sickness, of £700,000 annually. This sum, capitalised at 30 years' purchase, would give £21,000,000 sterling, or £50 per house—enough, under a competent administration, to pay for the primary works required for prevention." It is, therefore, a foregone inference, that ventilation is not by any means one-sided, but flows for the mutual benefit of employer and employed, teacher and taught. If, therefore, the individual and the nation invest in ventilating and admitting sunlight for enclosures, to which they have to repair and impair themselves, will the capital so invested not recoup itself, with interest, in the form of less sickness and more healthier constitutions?

Those who are very particular about their health take special pains in excluding from their dwellings that good medium in which they live, and move, and enjoy their being. Key-holes are closed, pads occupy the joints of doors and windows, every conceivable crevice is shredded, and, if the fire is unused, its opening must likewise be closed, or dosed with ornament. No wonder such careful persons feel cold, rheumatic, dizzy, and appetiteless after rearing themselves chalky, tender complexions, in *hot-houses.* Some people have such a horror at the feeling of fresh air, especially within their dwellings, that, unless it comes in and goes out of itself, in sufficient quantity, unfelt and diffusive, this good friend will be looked upon as a wolf in sheep's clothing. Women, especially, exert all their power in fashionably etiolating themselves, by blinding HEALTH'S SUNLIGHT, not only from their persons, but from every room of their domicile. Happily the close, rarified air of the room, and the cold, fresh air outside possess an affinity for each other, and press through walls and chinks in their desire to unite for the benefit and relief of these indwellers. The majority of apartments are possessed with no additional opening for ventilation than the fire-vent, and many bedrooms have not even this vent. Bedrooms, where people sleep one-third of their time, cannot afford to be without some permanent movement of fresh air and much light, where the exhalations of bodies are continually communicated to bed-clothes during the night, and by these clothes given off again during the day.

If there be no other opening in the room but the vent, an upward current of foul, and a downward current of fresh, is at once set in operation by the unequal states of the inner and outer air. The fresh air, in its downward progress, is frictioned by, and disputes with, the upward movement of the foul, thereby not made any purer or cleaner for entering the lungs of the air-starved inmate or inmates. For any ordinary-sized room, where there is a fire burning, the vent will have sufficient extraction power for four or five persons, provided it is a good-going vent. But when the air in the vent becomes colder than the air of the apartment, when the fire is unused, the vent then becomes an inlet for air flowing down to the room. Respiration, combustion, heat from the body, and rarified air all seek higher levels, standing in pools as water does at lower levels, but these also contain carbonic ingredients, which, like water, seek lower levels—hence the necessity of draining off the specifically lighter vitiated air at the highest point of the enclosure, allowing the fire-place, or other channel low down, to carry off the heavier impurified particles.

An ordinary fire, burning 8 pounds of coal per hour, requires 1280 cubic feet of air for combustion. A vent 10×10 inches, with a movement of 5 cubic feet per second, will extract 18,000 cubic feet per hour.

Dr. Parkes mentions 16 cubic feet of carbonic acid exhaled by man in 24 hours, and Dr. Wilson says "that 1 cubic foot of coal-gas destroys the oxygen of 8 cubic feet of air in combustion, and produces 2 cubic feet of carbonic acid, besides other impurities. As a common gas-burner burns about 3 cubic feet of gas per hour, the importance of having these deleterious products of combustion carried off by special channels will readily be admitted." Dr. Wilson also recommends a supply of "3,000 cubic feet of fresh air per head per hour in all cases where the diffusion of the contaminated air is uniform." Dr. Smith describes "air in nature as containing 21 per cent. of oxygen, and has noticed a candle go out in a mine with 2½ per cent. less of oxygen. Rooms, therefore, with less than 20·7 per cent. of oxygen are unwholesome." The latter also found the proportion of carbonic acid in the air of nature to be "·0336 parts of 10,000 volumes; streets of towns, ·0403; and close buildings, ·1604;" and says, "when people speak of good ventilation, they mean, without knowing it, air with more than ·07 per cent. of carbonic acid."

In providing an inlet or an outlet to meet the carelessness and indifference of occupants, and the ignorance of their domestics, it is necessary that both these openings be self-acting, the inlets partially movable in occupied apartments, permanent in others, and the outlets permanent in all places. The area of inlet for fresh air should possess some relationship to the area of the outlet. For all practicable purposes, the area of the former may possess a tenth more space than the outlet. But openings must also be regulated in area by the size of the room, the average number of persons likely to occupy it, the fire and light in use, climatic change; and while smaller openings are admissible in the country, larger ones are required in towns. For a town, the purest position having been selected for a supply, if the air is admitted through a filtering medium during all seasons, as well as through a heating one in cold weather, or a cooling one in hot weather, through a water spray also acting as a cleanser, it is well. The filtering medium, after being charged with sooty, chemical, dusty particles, requires frequent renewal; otherwise the medium only makes the dust-laden air more dirty. (The principal ingredients of coal-smoke are carbon, sulphurous and carbonic acids. London has constantly a cloud of 60 tons of these and other more foul ingredients floating in its air.)

In admitting a fixed quantity of fresh air to all places in the winter season, for instance, the space for that season, as well as for all other seasons, could be permanent, with provision for always admitting more than the standard quantity for all seasons. Less ventilation, of course, becomes necessary in winter, as at that season there is less ærial moisture held in solution than in summer; hence the necessity for some contrivance, if it can be contrived, in the form of a clock, on which each season or month would adjust itself to the requirements of the space to be ventilated. As some people cannot always risk or exert themselves in a room with an open window, they must have air mechanically introduced for them—the object of this mechanism being the infusion of a sufficiency of air at all seasons, admitted diffusively, wholly or partially self-acting, drawn through heating, filtering, or cooling mediums, or other direct sources, in accordance with the season and place—thus obviating uncomfortableness, excess, or draught.

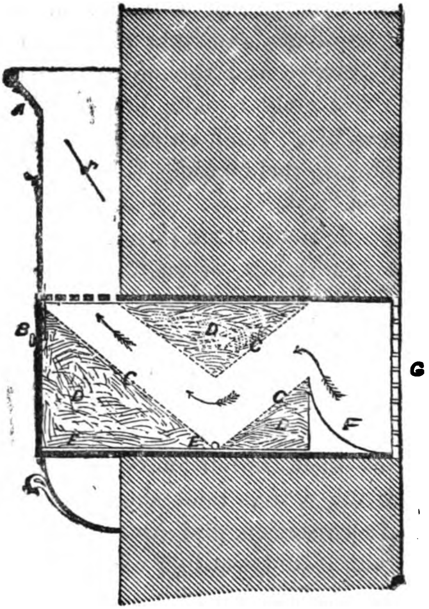


FIG. 2.

A in diagram denotes the inlet-tube; B, drawer; C C C, wire netting; D D D, ice; E E E, non-conducting packing; F, deflecting plate; G, grating in wall; H, regulating valve.

"Fig. 2 shows the arrangement for cooling the air in hot weather, manufactured by Robert Boyle & Son. It consists of an air inlet-tube of bracket form, made of iron. The part which penetrates the hole in the wall has an outer casing, so that a space of about ½ in. is left, between which is packed with non-conducting substance, for the purpose of preventing the heat from the wall penetrating into the interior of the opening, and acting upon the blocks of ice which are placed in a movable drawer, and kept in position by means of open galvanised iron or copper wire netting. The front of the drawer is also double, and packed same as casing. The outer air entering through the grating is deflected by a metal shield on to the suspended blocks of ice, and from thence on to the ice at the bottom of drawer, and thence up the tube into the room, it being not only cooled, but purified thoroughly from blacks, dust, etc. Such an arrangement would prove very acceptable in fashionable London drawing-rooms during the season."

Whether the air is admitted through tubes, hooded wall gratings, heated, filtering, or cooling mediums, windows, or other means, it is agreed amongst the majority of hygienists that, from whatever direct or indirect source it is drawn, it should enter the enclosure six feet or so from the floor, at an angle of forty-five degrees. By coming in at such an angle its movement is directed upwards, and thereby diffuses itself unfelt more readily. Whatever form of inlet it takes, that inlet should be also capable of inspection and cleansation, and its mouth hooded for the checking of draught and warding off wind.

An ordinary-sized room, with three persons, will probably require 9000 cubic feet of fresh air per hour, entailing inlet openings of 240 square inches. A space containing 1500 cubic feet, and 240 square inches of openings between natural unequal temperatures, will set in motion 9000 cubic feet of air per hour—a movement capable of changing the air of the space three times during the hour, travelling at the rate of one mile an hour, or 1½ feet per second—a movement unfeelable, and not until three times this speed is reached by increased unequal states, or in a movement equal to that up an ordinary fire-used vent, will it be perceivable.

Nº 2

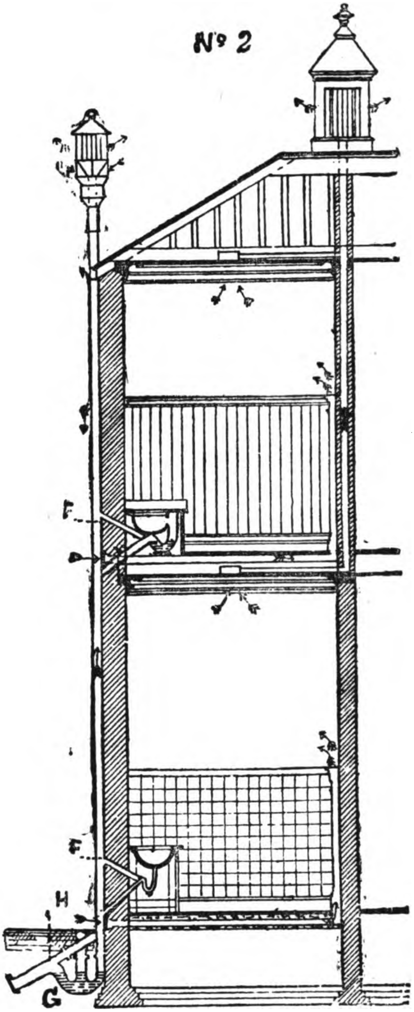


Figure No. 2 above is a section of part of a house, shewing inlets for fresh air, about seven feet from the floor, also central ceiling outlets, the latter surmounted by an efficient Boyle's Air Extractor or Ventilator. By the inlets fresh air is admitted in a diffusive upward direction, and the vitiated air completely carried off by the tube attachments, with the extractor in a constant unfeelable manner.

Coming to outlets, if the room possesses no other but the fire-vent, the air at the ceiling will always be more or less heated and dirty, while it also moves upwards, downwards, and to and fro, that condition is likely to be increased; whereas, were an additional opening provided at the highest point of the ceiling into the vent, or into a separate space alongside the vent, or into a tube communicating with a trunk, situated at an elevation outside, on which would be placed a vacuum air-pump ventilator, the rarified air would be continuously drawn up to supply the vacuum caused by the current of the outer atmosphere playing upon the mechanism.

The disadvantage of connecting an ordinary outlet shaft with a vent or channel alongside thereof, is that, when the vent is cooled by the ceasing of the fire, this channel then becomes an inlet for the outer air. Unless the chimney-head is provided with a canopied extractor there will not be an induced constant upward current created from the apartment.

The public are indebted to Messrs. Robert Boyle & Son, of Glasgow and London, for the invention and application of a correct principle of "extraction," by them so successfully applied to many public and private buildings throughout the country, which is also capable of application to railway carriages, ships, and mines. Their ventilator consists of four sections, each acting independent of the other. "No. 1, in plate 2, shews a curved baffle-plate or guard to concentrate the current, and to prevent the wind blowing through the slits opposite; No. 2, a curved plate to take the pressure off the vertical slits communicating with the internal chambers and to prevent down-draught. The external air impinging on the diaphragm 3 is deflected on to the central radial plate 4, creating an induced current, and in its passage drawing the air from the vertical chamber 5, expelling it at the opposite opening. The foul air immediately rushes up the shaft connecting the ventilator with the apartment being ventilated to supply the place of the air extracted, thus securing a continuous and powerful upward current. No. 6, in the same plate, shows the partitions separating the chambers and preventing external air being drawn through the slits upon which the wind is not directly acting."

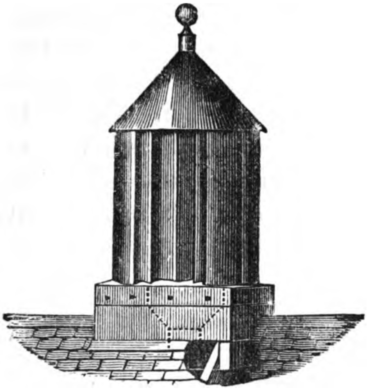


Plate 1.—Elevation of Boyle's Plain Air-Pump Ventilator.

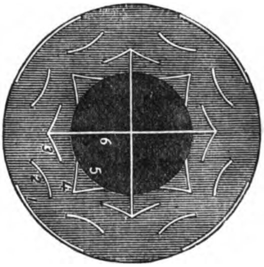


Plate 2.—Plan of Air-Pump Ventilator.

All gasaliers suspended from ceilings, or gas light wherever introduced, should possess special channels for carrying off the products of combustion, which may also be made extractors of the foul vapour of the room. These may all be attached to the shaft in communication with the self-acting air-pump ventilator, or to a special channel alongside the vent, but not into the vent itself, as there the tube is liable to be choked with soot. Although fresh air will flow into the house by open windows, or other direct opened external means, at all seasons, the passing it through a heated medium in the lobby, hall, or staircase, or through a space attached to a fireplace during winter, will always cause an agreeable temperature when admitted, unburned, at 55 to 60 degrees Fahrenheit. For a large house the lobby, hall, or staircase are perhaps the best spaces to heat by a coil of pipes, or other means supplied by heat from the kitchen fireplace, or a gas jet, if the lobby is not provided with a slow combustion stove heater for itself. A tank which keeps hot water in store for a bath room, etc., occupying a screened recess, will do double duty for heating certain parts with fresh air, if the outer air is admitted to play upon the tank as it enters—the advantage of so using any of these central spaces as mediums being, that they readily contribute their warmth to the apartments surrounding or attached to them.

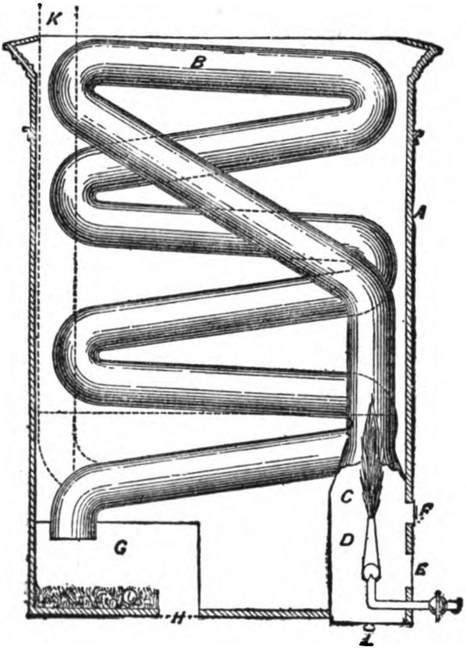


Fig. 1.—Combined Outlet, with Heated Inlet.

Fig. 1, invented and supplied by Boyle, is an economical form of air-warmer, by means of a gas jet.

"With this arrangement the air supply can be raised from a temperature of 30° to 130°, and to shew that it is one of the most economical methods of heating in existence, it is only necessary to mention that the cost of gas consumed to raise the incoming air from a temperature of 40° to 100° is less than one farthing per hour, this being effected with the air passing through the tube at a velocity of 300 feet per minute, or 18,000 feet per hour." The dimensions of the inlet-box containing the zigzag tube are 24 × 16 × 6 inches.

This coil of pipes is placed in a box or tube, 24 × 16 × 6 inches, which may be placed in a recess or set on a wall bracket, about 6 feet from the floor to the top of the box. The coil of pipes are soon warmed by a gas jet, placed within the mouth of the inmost tube, and the heated fumes pass away through the zigzag pipe to the outside, or into a vent. The inflowing air, passing over the zigzag coil, absorbs the heat and scatters it to the room. In this manner, by the time the heated fumes reach the outlet and are liberated, heat has been communicated to the coil over which the inflowing air is heated as it is ushered into the apartment. Wherever a fire or a gaslight is used, their heated foul air outlets or vents, when combined with surrounded or partially-attached channel inlets, allow the heat imparted to the outlets to be utilised and carried to the apartment while obtaining the inflowing fresh air. These channelled outlet and inlet combinations become of mutual assistance for ventilation; while the foul air is being extracted in a separate channel, the fresh air is induced to come to the apartment on a road, whose partition is kept warmed by, but separated from, the outflowing foul air. If a window is raised or lowered, the air flows in as a draught, which, of course, cannot always be suffered; it is therefore intended to shew, in the sequel, how common windows, etc., may be made to ventilate a room, by giving the inflowing air an upward impetus by which the feeling of draught is diffused and lost.

In hung windows, or vertically-moving sashes, a piece will always cause an agreeable temperature when admitted, unburned, at 55 to 60 degrees Fahrenheit. For a large house the lobby, hall, or staircase are perhaps the best spaces to heat by a coil of pipes, or other means supplied by heat from the kitchen fireplace, or a gas jet, if the lobby is not provided with a slow combustion stove heater for itself. A tank which keeps hot water in store for a bath room, etc., occupying a screened recess, will do double duty for heating certain parts with fresh air, if the outer air is admitted to play upon the tank as it enters—the advantage of so using any of these central spaces as mediums being, that they readily contribute their warmth to the apartments surrounding or attached to them.

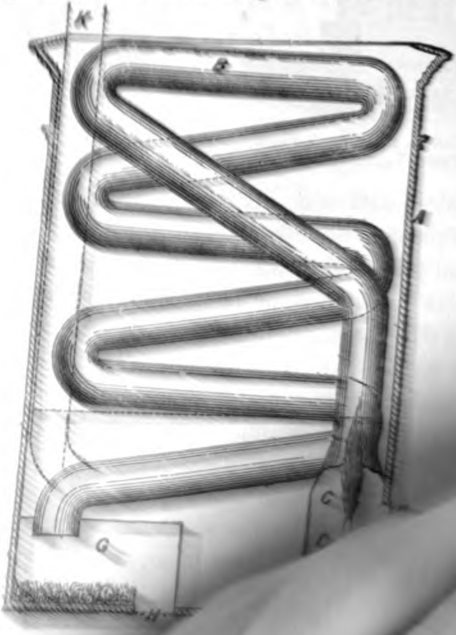


FIG. 1.—Comb

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from a temperature of 30° to 130°, and to shew that it is one of the most economical methods of heating in existence, it is only necessary to mention that the cost of gas consumed to raise the incoming air from a temperature of 40° to 100° is less than one farthing per hour, this being effected with the air passing through the tube at a velocity of 300 feet per minute, or 18,000 feet per hour." The dimensions of the inlet-box containing the zigzag tube are 24 × 16 × 6 inches.

The coil of pipes is placed in a box or tube, 24 × 16 × 6 inches, which may be placed in a recess or set on a wall bracket, about 6 feet from the floor to the top of the box. The coil of pipes are soon warmed by a gas jet placed within the mouth of the lowest tube, and the heated fumes pass away through the zigzag pipe to the outside, or into a vent. The inflowing air, passing over the zigzag coil, absorbs the heat and scatters it in the room. In this manner, by the time the heated fumes reach the outlet and are liberated, heat has been communicated to the coil over which the inflowing air is heated as it is ushered into the apartment. Wherever a fire or a gaslight is used, their heated foul air outlets or vents, when combined with surrounded or partially-attached channel inlets, allow the heat imparted to the outlets to be utilised and carried to the apar[illegible] while obtaining the inflowing fresh air. These [illegible] let and inlet combinations become of [illegible] ventilation; while the foul air is [illegible] ate channel, the fresh air is [illegible] rtment on a road, whose par- [illegible] separated from, the outflowing [illegible] raised or lowered, the air flows [illegible] of course, cannot always be [illegible] intended to shew, in the sequel, [illegible] etc., may be made to ventilate [illegible] inflowing air an upward impetus [illegible] draught is diffused and lost.

[illegible] or vertically-moving sashes, a piece

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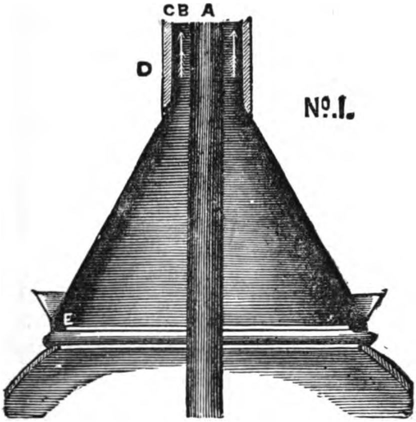
of wood, two inches or so in depth, to suit the amount of air wanted, should be fixed between the batten rods or beads, close to the top of the upper, or bottom of the lower sash. This piece of wood remaining fixed, the top sash may be lowered, or the bottom sash raised, when air will flow in between the lowered, or raised meeting rails to the apartment at an upward angle. A permanent supply of air to the room may also be obtained in the forming of a slot, cut out between the meeting of the central cross of the sashes, without raising or lowering them, to which could be added a regulator for increasing or diminishing the supply, or, if in a town, also a movable filtering medium. The diffusion of inflowing air is accelerated in passing through cone-shaped or other openings, possessing many times more capacial area towards the interior than on the exterior. Where windows have only single dead frames, containing sashes neither hung, swung, nor hinged, the simplest way to admit air at the required angle, is to cut out the lower part of one or more panes, to the extent of a fourth of their height—glazing the inside of the sash opposite the part so cut out, reaching within a third of the top or tops of the pane or panes; there will then be a space formed by the partial double glazing applied to the outer and inner side of the astrigal or sash, for the air to flow in without being perceivable. Air may also be admitted without raising or lowering the sashes, by the introduction of fixed or movable glass louvres, occupying square or oblong spaces in the sash. These louvres being horizontal pieces of glass, so placed, that each piece overlaps its neighbour to an upward acute angle, they form convenient neat ventilators, and may be applied, in any style of architecture, to any window for a regulated or a permanent air supply. It may here be noted, in speaking of windows, that they cannot always be kept in a sanitary and cleanly condition without risk to the Cleaner, unless all sashes are made to swing open to the inside, in addition to their other movements, as without such addenda their facial hindrances get tarnished in being often moved or forced for the cleansing operations.

XII. LIGHTING AND HEATING.

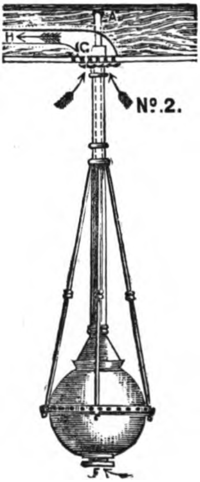
As gas superseded candles and oil, so, in turn, will it come to be superseded by a more sanitary electric illuminant for public, if not ultimately for private enclosures; the disadvantage of gas as an illuminant being the poisoning of the air by the products of combustion, and robbing it of vitality; its readiness to leak from inferior connections, unused, accidentally perforated, or decayed pipes; to become a secret suffocater or blood-poisoner of the inhabitant; besides the uncleanness it conveys to furniture and decoration. On the other hand, the use of electric light does not impoverish the air nor raise the temperature to any appreciable extent, possessing a saving value in internal decoration, renewal and preservation of works of art.

When introducing gas to the house, the meter or measure for it must be placed in a dry and accessible position, not higher than three feet from the floor. All pipes supplying the meter with gas off the company's main, or conveying gas from the meter to the varied premisial apartments and places, should occupy accessible and indicated positions. A neat form of pipe, exposed or protected, must always be better than an inaccessible concealment, as any error in construction, or accident, or decay, can be more easily seen and rectified, without undue injury to the internal parts of the house, so frequent in searching for hidden pipes. Hanging pendants or gasaliers from ceilings are generally perpetual sources of leakage, not only to the room they occupy, but to the apartment immediately above them. These hangers have a sliding movement, and in the space allowed for this action the gas has access, which can only be partially retarded by keeping the movable space filled with water; but the water gets gaseously saturated, and by evaporation pollutes the apartment. The constant application of water can thus only partially prevent the escape of the gas from such hangers to the apartment; and only by covering the water held there with a little oil, to form a surface skin, can evaporation or emission of the gas through it be retarded for a time. There are no vertical movement hangers free from gaseous escape, the only apparatus that are comparatively perfect in this respect being brackets with horizontal movements; and, least of all, are those mechanisms with immovable or fixed joints. All sleeping apartments must undoubtedly be more healthy, and possess less subtle risk from dilapidated pipes, without any gaseous introduction whatever; and wherever this useful commodity is introduced for domicile, workshop, or public enclosure, a channel or vent for carrying off its poisonous products of combustion becomes an indispensable attachment. No one, unless some rural, out-of-the-way Highland neighbour, thinks of having a fire in his domicile without there being an outlet vent attached for carrying off the waste of combustion. The Highlandman's shieling, with his fire in the middle of the apartment, generally has an opening in the centre of the roof above the fire, which serves as a ventilator, although it does not prevent the smoke reaching all parts of the interior, ere making its escape, as much by the doorway and turfed shelter itself as by its roof opening. Exactly the same thing takes place in the house of the Highlandman's town neighbour, by allowing products from gas combustion, instead of those from peat, to search all parts of the interior for liberation. Those who keep canaries or flowers in their sitting-rooms (however unsanitary it may be to keep these in spaces also used as bed-rooms), are aware, that such objects soon begin to droop, and often die, when exposed to a gas-lit, product-retained, polluted atmosphere. Now, what must be the effect on each pair of human lungs, in the impoverishment of the blood, the weakening of the system of young and old, by continual submission to an atmosphere in which ventless gas-lights and unventilated rooms add their quota to other nameless impurities?

The following diagrams illustrate an invention by Messrs. Robert Boyle & Son, applicable to ceiling gas-pendants, and wall brackets, for completely removing the products of gas combustion in buildings, so hurtful to health and injurious to furniture and internal decoration:—"Diagram No. 1 shews a section of a hall pendant. A is the gas supply pipe; B, ventilating pipe for drawing off the heat and products of combustion; C, non-conducting packing between inner and outer pipes; D, 1½-inch outer pipe; E, gutter on bottom of cone above globe to receive any condensed vapour which may be formed in the pipes. There is no possibility that this gutter can become full and cause an overflow, as the strong and continuous rush of air up the ventilating-pipe, created by the air-pump ventilator on the top, will cause it to evaporate and be carried off. Diagram No. 2 is a hall pendant, shewing external appearance. Diagram No. 3



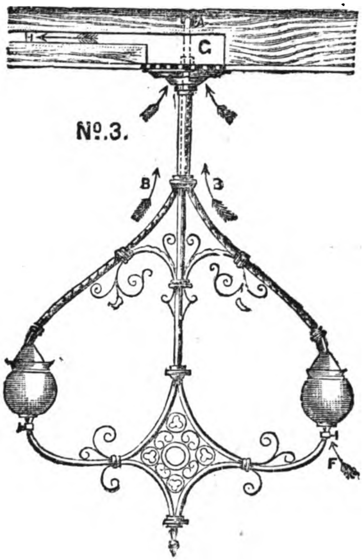
No. 1.



No. 2.

shews how the principle can be applied in an ornamental form to gasaliers. F is air inlet at bottom of globe to support combustion; G, foul air chamber above ventilating centre flower; H, ventilating pipe to draw off the heat from the gas, and the vitiated air from the room.

No. 3.



This pipe is led between the joists to the wall and continued up to the roof, where it is connected with an air-pump ventilator, which creates a powerful upward current, and effectually prevents down-draught."

Thin tin pipes are, of course, more liable to decay, yet they are invariably laid by speculators and unscrupulous plumbers in lieu of a better article. This peculiar composition of pipe, like all spurious imitations, or individuals, however, has a determined imitated appearance and pretence of being genuine. In most houses of the speculative order, strong durable pipes for the conveyance of gas or anything else must be considered a decided rarity. In houses built to order, under a specification, where a substantial article is asked, weak pipes sometimes also lie hidden, or are caused to be hidden by those particular individuals, who not unfrequently proclaim their sanctity in public and private places. An inspector may thus be thrown off his guard by their much speaking of things sacred.

Substantial pipes are not unobtainable in stronger compounds of block metal, iron, lead, brass, and copper; and there can be no excuse for using solder, instead of brass or copper couplings, when the latter are wanted and specified.

All pipe branches and unions are incomplete without proper couplings, without which testing for gas escapes cannot be so handily accomplished, unless by injuring or cutting the pipes, when there is a deficiency of these accessories.

When pipes are laid in inaccessible hidden crevices, there is always some risk of fire being communicated to dry, inflammable material of the contacting crevice by the plumber's red bolt, which may slumber for a time ere ignition takes place, after solder has been added to some already over-soldered branch.

HEATING.—That the aggregation of individual fires contribute to the ærial sewage of all large towns is a foregone conclusion. The countless tons of unconsumed smoke being carried there by so much unconsumed coal from imperfect combustion, the greater part of which must be considered so much preventible waste, caused by using defective heating apparatus and the principle adopted for the conversion of the fuel into heat. It is needless to say that the compulsory abatement of smoke must be effectually dealt with at the sources of its production, which will not be accomplished in a few years, nor perhaps in many years to come, although it is believed and hoped it may be satisfactorily accomplished. Could the greater part of smoke be compulsorily abated in all towns, as it might be in the use of anthracite or gaseous fuel, or where raw material is burned, in an appliance attachment to all fires capable of burning the smoke with the fuel, greater cleanliness, saving of labour, soap, and decoration, would not only result to the household, but the air outside in these towns would be appreciably cleaned and cleared of many sooty clouds. If three-fourths of the soot that at present fills the air were consumed, towns would possess comparatively clearer atmospheres, and the success of any appliance for the purpose will be greatly determined by the economical value it possesses in the saving of heat, three-fourths of which, when produced in ordinary open fires, escape by the chimneys. If three-fourths of the heat so produced can be saved—and there is no reason why it should not be utilised—three-fourths of the fuel for its production will also be economised. An open fire-place yields only one-fourth of the heat produced, the remaining three-fourths passes up the vent; a close, slow combustion stove is different, which only loses by the vent one-fourth of the heat produced. A stove for the production of a healthy heat is expected to vomit a sufficient supply of soft, fresh air to the apartment, which it must first draw from the outside through itself, without that air so supplied coming in contact with its fuel. The heat from a stove or open fire is intensified by the fire-chamber of either being surrounded with fire-brick. As open fires are pronounced the healthiest formation for heating and ventilating the apartment, how are they to be altered or added to, so as to consume the greater part of the smoke from the burning of raw material, save the fuel, and economise the heat? If an open fire is so constructed that no air can reach it from below, but must pass over its face, slower combustion takes place, the smoke is partially burned by the direction and action of the air. The heat does not ascend so easily into the vent as is the case when continually puffed up by a stream of air entering below the fire, while the fire-brick above and on all sides retains and reflects the heat to the apartment, and by a wise arrangement also assists in the consumption of the greater part of the smoke.

Any grate, with a slight addition, will produce slower combustion by a close-fitting ash-pan occupying the entire space between the fire-bars and the hearth, that no air can reach the fire from below, but must pass over the fire-face. An application of this kind will probably save two-thirds of fuel with a diminished smoke ratio, the third of the fuel being burned slower, by which the heat is not carried away to the same extent by the vent, but escapes more readily into the room, producing the same heat to the apartment as the burning of two-thirds more fuel.

If a fire burns itself downwards or is fed from below, the greater part of the smoke will naturally be absorbed and burned. Again, if the air be directed to pass over the face of the fire, or down through it, or by other means by which the sooty products are caught and utilised, smoke will be abated and fuel economised. The Association for the Prevention of Smoke and Economisation of Fuel, at their premises, 16 Baker Street, London, W., shew excellent heating appliances whereby the abatement of smoke and the combined economy of fuel may be accomplished. They also supply smokeless and other kinds of raw fuel at reduced rates. Their smoke preventer and fuel economiser is obtained for fifteen shillings, and is applicable to any existing grate or open-fire range burning coke, anthracite, or ordinary coal. It consists of a loose *fire basket* with a hood reaching nearly to the top of the fire, excluding cold air from the chimney, and within the hood is a swinging diaphragm. This diaphragm can be regulated by a knob attached to the hood for retarding or increasing the rate of combustion, also for drawing the whole of the smoke and products of combustion into the current of hot air within the hood, whereby it is oxodised at a high temperature, and the greater part of the smoke is thus burned, while the heat is retained by the basket and given off to the apartment.

A good kitchen cooking-range or stove must possess the principle of conversion for either an open or a close fire, should consume the smoke, save the fuel, economise and conserve the heat produced for other parts of the house, ventilate the apartment, ventilate itself, so as to produce no smell from cooking; and the more simple the mechanism the easier will it be managed and kept in order. The "Simplex" Cooking Range illustrated in the Appendix, made by Messrs. Walker, Hunter & Co., Falkirk, N.B., possesses many good qualities, besides that of simplicity, not to be found in many other cooking contrivances. For large houses generally, where much cooking and hot water are required, this range must be highly commended.

Grates entirely enclosing the fire with iron, known as "registers," tend in great measure to conduct the heat up the vent as it is produced; besides, they have the nack of never fitting close to the space they occupy, allowing a vacancy behind the grate wherein cold air circulates, which frequently causes a smoky fire-place.

Fire-brick, being a non-conductor, but a powerful retainer and reflector of heat, is one of the most economical enclosures for a fire, in conserving the heat produced for the apartment. It is usually associated with grates known as "Kinnaird." These grates are superior to any form of "register," inasmuch as they are made more solid to occupy all the space, leaving no lodgment for cold, stagnant air behind, which reduces their tendency to smoke, produced by other less close-fitting or more open enclosures.

A separate chamber attached to a fire-place, into which fresh air will be drawn from the outside ere it is admitted into the room, or place to be heated, becomes at once an economical means of obtaining fresh-heated air and utilising the surplus heat there generated for other parts, as well as for ventilation. The variation of temperature produces motive power for ventilation, as well as for smokiness. If, therefore, a flue or fire-vent is warmer than the outer air, an upward current will at once establish itself; if colder, a downward current takes place. Flues in outer walls are thus more liable to smoke than those in inner walls. The outer walls being exposed to cold, piercing winds, the vents get chilled, whereby their currents are reversed, causing blow-downs and intermittent smoke-whiffings to the apartment. There is, however, a remedy for such, or other obstinate or dilapidated drawing flues, so affected by their ill construction or external surroundings, by surmounting them at the chimney-head with a can, on which the cold winds will cause a vacuum at their top in the establishment of a continual up-current instead of a down one. By this application to the mouth of the chimney-head, *the moving cold atmosphere*, whose access to the vent produced the disagreeableness of smoke or a blow-down to the inmates, may be utilised, and its movement changed by such an apparatus into that of agreeableness for a constant upward and ventilating movement. A close room, into which little air is allowed to enter, sometimes causes a smoky vent, on account of the combustion being obliged to draw its supply of air from the same channel as carries away its smoke.

In the erection of lesser houses, the heat of the kitchen or other fire might be more utilised, as the heat from the kitchen fire generally is in large houses, by the circulation of hot water or steam to a greenhouse, hall, bath-room, and other places and purposes to which it is directed, or turned off by suitably-placed regulators. Hot water and steam, unlike hot air, lends itself in a variety of ways for public or private heating, by which heat and ventilation may be more readily supplied to a number of houses from a common source, like gas or water. Air heated, however, by pipes enclosing hot water or steam, unless a sufficient quantity of fresh air is heated on its admission by contact with these pipes, and simultaneously supplied with the heat to the apartment, the air of the apartment sooner produces a languid feeling on the inmates than when fresh air is drawn directly and quickly from the outside, heated by contact with a separate chamber attached to an every-day fire, by which more apparent invigoration and cheerfulness are expressed on the inhabitants.

XIII. THE INTERIOR.

"A thing of beauty is a joy for ever."

A CLEAN, smooth surface is obtained by building or lining the inside of all dust-bins and dust-shafts, the walls of water-closets, lavatories, common stairs, etc., partially or wholly, and the lower parts of kitchen quarters for domestic operations, and many other places, with glazed bricks or tile linings; but the lining of the whole walls of tenemental living apartments with highly-glazed bricks cannot be recommended, as the cold, glazed surface condenses moisture, is non-porous, or, like a waterproof coat, retains and does not exhale the perspiration of the inhabitants. The lining of the lower part of the walls, four feet from the floor, is sufficient for cleanliness. The painting of walls, inside and outside, interferes, also, with their natural porosity; and the question arises, To what extent should intermediate floors and partitions of tenemental dwellings be so constructed as to prevent the perspired air of the one house entering that of its neighbour? Cement makes a durable and smooth coating for the lower part of walls; while coloured cement selenitic makes a washable, hard, and smooth surface for the dados of the rooms of better-class houses. The slow process of raw plastering, handed down from father to son for generations past, must hold its ground until, at least, some other equally good but speedier process, in a finished, dry composition, takes its place — perhaps in lime, non-inflammable asbestos, or paper, but smooth, flush, close-banded together at the unions, yet with flush-pannelled, less-monotonous, and more easily-dried surfaces than possessed by ordinary plastering.

"An apparatus for drying houses or rooms newly plastered has been patented by Kosniske, of Warsaw, which is capable of renewing the air at the rate of 1000 cubic feet per minute, 7000 cubic feet of space being completely dried at Warsaw in a 14 days' application. It is also capable of raising the temperature for disinfecting purposes to 660° Fahrenheit."

For bed-rooms and the working part of the house at least, the fewer crevices, corners, and undue mouldings introduced, the more readily will these places admit of cleanliness, and dust lodgment be prevented.

Form may be plain and simple, as it may be beautiful with or without carving or ornament. When ornament grows out of useful forms, subordinately clothing these forms to condition them by the whole, that whole is united and blended as it is conditioned and dignified by its parts. Utility and beauty are at once united and mutually invigorated for the education and elevation of the mind, as education and mind may again be debased by a vulgarism "stuck on" merely for ornament, without the least adaptation to either harmony or order, as may be seen in the most of plebeian work. Nature alone is beautiful, and art is artificially beautiful to the extent in which its artificiality is capable of receiving and transmitting naturally that order and usefulness arising out of that variety and uniformity to be found in nature. The physiological sensations transmitted by art are, therefore, more or less intensified by the harmonious variated order arising out of its more or less happy union with utility. Again, the sublimity of a work of art decreases with the increase of decoration bestowed upon it, unless it is associated with the pleasing—the beautiful.

"Toutes les grandes époques artistiques ont été des époques de liberté." If that liberty and originality is too much absorbed in academical routine and official teaching, and fettered by mere read rules, art becomes barren to the extent of that slavery and the degree of its tyrannical subjection. Individuality by this means is partially lost; its sensations, instead of being infused into or emphasised on the work, are blunted; there is less sympathy between the artist and the work's intention; while the finer feelings capable of being conveyed through it may only vulgarly transmit themselves from combinations cheerless and soothless, which might otherwise elevate and please the mind, had the artist more naturally and less artificially understood and individualized his intention.

All internal wall-washes, papers, or decorations, unless capable of being washed or otherwise cleaned without surface injury, are not the most sanitary. Air-dust collects on walls as well as on furniture, and putrifies where not regularly removed, and, of course, transmits a fusty, unwholesome smell to the room — hence the necessity for surfaces cleanable and washable. A washable mixture for colouring walls may be obtained from a combination of "three parts of flint, three parts of marble and sandstone, and two parts of burned china-clay, mixed with two parts of freshly-slaked and still warm lime, which gives a mass for coating walls which, by frequent watering, is changed into a silicate of porous, stone-like texture. The four ingredients, well mixed together, are said to supply a grounding which may be added to any colour usable with lime. The mass is thickly applied, and left to dry until the next day, when water is poured over it at intervals, by which the coating becomes weather-proof. The coating thus obtained can be washed without giving off any colour. The mass becomes firmer by the application of water, and may also be brushed. The mass may be used both for the most coarse and the finest painting. With it a so-called fresco layer may be produced in the dry way." A porous silicate, capable of being applied like paint and cleansed with water without losing its adherence or colour, has a sanitary interest for bed-rooms, working spaces, and many classes of property.

Regarding the papering and colouring of walls, this subject cannot be better explained than from the following letter by a renowned authority:—

POISONOUS WALL-PAPERS AND WALL-COLOURS.

Surgeons' Hall, Edinburgh.

In the majority of poisonous wall-papers the colours are more or less loosely attached to the paper; and the mere dusting of a wall with a cloth or brush will detach some of the colouring agent, as an impalpable powder, which becomes diffused in the atmosphere of the room, then settles down for the time on carpets or floors, bed-hangings, cornices, etc., to be disturbed again and again during cleaning operations. The same remark applies to poisonous colours, which are laid on walls with size and water, as practised in distemper work, and which are so often loosely adhering to the walls that they become detached in powder more readily. The diffusion of poisonous particles, whether of arsenic, lead, or copper, through the atmosphere of a room, is certainly most undesirable, leaving the question of volatility to the side; for it matters little whether the poison is inhaled in vapour or in impalpable powder.

Whilst the green colour is the most to be dreaded and warded against, yet this and other colours, whether they are poisonous from arsenic, lead, or copper compounds, should never be employed in paper-hangings or in distemper work, where the colour is so easily detached. A single grain of the poison in a square foot of the wall-paper or wall-colour means 500 to 1000 grains of the poison in an ordinary-sized room; and if there are 10 grains of the hurtful substance (which may be regarded as an average quantity), then 5000 to 10,000 grains may be laid upon the walls of a single room. It is no palliation of the mischief to argue that such quantities are only to be found in cheap papers or cheap distemper colours, even though it were correct to say so; for the poisonous material should not be there at all. Some years ago, ordinary green pickles could scarcely be purchased without having been treated with a copper salt; but the Adulteration Act proved the death-blow to this mode of disseminating copper poison, and the public are now more wise, and are thankful for the unpoisoned pickles. Similarly with wall-papers and wall-colours, an Act should be passed forbidding the use of poisonous substances in paper-staining, and in wall-colours for distemper work, and the public will learn to appreciate non-poisonous wall-papers and wall-colours, and be all the more healthy for the change. In Germany and France the authorities are much more strict in such matters than we are in Great Britain. Quite recently the Prefect of Police in Paris has notified a most stringent prohibition regarding the use of poisonous substances in the colouring of *even wrapping papers*, and has intimated that manufacturers and dealers will be held responsible for accidents which may occur from the employment of such.

It is to be hoped that, before long, our paper-stainers and colour-makers will announce to the public that they are prepared to send out all their wall-papers and wall-colours free from poisonous ingredients. In the meantime the public, for their own protection, should insist that the articles supplied to them be guaranteed to be *free from arsenic*, *lead*, or any other poisonous compounds.

I am, etc.,

STEVENSON MACADAM.

A discussion has taken place between some of the wall-paper manufacturers and Dr. Stevenson Macadam regarding wall-papers, in which arsenic is more or less used. Having been a sufferer from the effects of such papers, I can contribute some experience on the subject.

About 18 years ago my dining-room was papered with a flock paper, green and gold, got from one of the leading firms of house-painters in Edinburgh. The colour was bright and pleasant to look at, and no fault could be found with it in that respect. The papering was done when the days were long, and no bad effects were felt at first—at least, to awaken any suspicion—till the long nights set in, and gas had to be used for hours together. As the winter progressed, my wife and I could not understand how it was that by nine or ten o'clock at night, when we were in that room, we always felt sleepy and uncomfortable, and my eyesight began to be affected to such an extent that a fear crept over me that I was beginning to lose my sight. That continued for some time without the cause of it being suspected, till a friend suggested that the wall-paper very probably had something to do with it. The paper was accordingly subjected to a test, and arsenic was found to have been largely employed in giving the paper its fine bright colour. The room was at once abandoned and another occupied, when the whole symptoms disappeared, and we were both quite well again. There could be no doubt hatever that the paper was dangerously unfit for use. The heat of the room and the gas together must have detached the small particles of poison and put them in circulation, so as to affect both the eyes and the throat. Dr. Macadam deserves praise for drawing attention to the subject, and thereby saving many from the injurious consequences.

I am, etc.,

A. V.

In the light of these facts, it is evident that the public cannot be too careful in the selection of wall-papers and colouring materials, stamped by known manufacturers.

Paper is a most useful material for the covering of walls: it retains warmth, is a non-conductor of heat, thereby prevents its too rapid loss through the walls it covers, and for cleanliness should be manufactured in surfaces perhaps more washable than hitherto, as it should also be free from all poisonous ingredients, and its composition incapable (as is frequently the case with cheap paper) of detaching itself by heat or moisture, and flying off as dust, to mingle with the air of the room.

As will be seen in the Appendix, Messrs. Woollams & Co., of London, direct their attention specially in the use of non-arsenical ingredients for the production of sanitary paper, whose manufacture has always been highly commended. Paper is generally put on walls with ordinary wheaten paste; in process of time this paste decays behind the paper and swarms with vermin or low forms of life. Not unfrequently new paper is laid over the old, forming additional material behind it for the propagation of putrefactive germs, that will sooner or later detach themselves, to be breathed into the blood of the inmates, where, finding a moist-heated soil in which they can multiply, they may kill their victim, unless he is able to free himself from them. All old paper should be washed off to the bare plaster, as the paste used for sticking the paper on the walls contains a *nidus* for germ formation. It is also necessary that the paste be prepared with a proportion of carbolic acid or other antiseption. But as ingredients such as lead, arsenic, copper, and antimony salts are used in the manufacture of paints to produce bright colours, as well as for paper, such and many others of a poisonous character, possessed of the most beautiful dazzling lustre and most tempting variegated hues, are to be suspected and avoided as disguisers of truth and pureness.

Paint—non-poisonous—has its place for internal decoration, or as a preservative agent for wood or iron externally, but when applied to cover the natural fibre of inside wood-work, is misappropriated. It may be an indispensable covering for the deficiencies of jerry work, hypocritically adapting itself in either flaming or quiet colours to suit more vulgar or more refined taste, and by the glossiness of its colours and its apparent sublimated truthfulness, disguises the more or less subtleness, selfishness, and deceptiveness of the workmanship it covers. For internal wood-work, varnishing or polishing its natural grain, through which its truthfulness shines, must have an infinitely higher aim and influence for mankind than any form of paint disguisement. In the varnishing of such internal wood, the essential ingredients of the material to be so used are, firstly, an antiseptic quality, and secondly, an efficacious fire-resisting equipment. As may be seen in the Appendix, this want is supplied by Messrs. Bell & Co., of Glasgow and London, who manufacture an asbestos fire-resisting liquid, as also felt applicable to many forms of construction and internal work. Such an application goes a long way to reduce fire-risk in public as well as in private buildings, domiciles, and stables, and is an inducement for much lower premiums of insurance that fall heavily on hazardous classes of property.

Proceeding to embellish the interior of a room, there is the proportion to be considered, the action of reflected light on the colour to be used, giving width and height by apparent increase or diminishment, the architectural features to be lightened or heavied, the endorsing them with variety and uniformity without monotony — all produceable by the arrangement, emphasision, and expression by the colouring of the several parts in relation to the whole.

If the artist and decorator can mutually understand and agree with each other, the space to be operated upon will gain in richness of expression. If both are unacquainted with architectural thoughts, movements, and meanings, the one will not help the other, nor sympathise with the work in expressing the necessary parts for harmonious treatment. But the room, all the same, may be decked, as a woman may array herself in tasteful or untasteful shapes, and gaudy or ungaudy colours, which may or may not improve her Maker's architecture.

Apparent height may be obtained by arresting attention to features high up in the cornice or ceiling margin, as evident width or breadth may be obtained by expressing horizontal movements. The architectural intention may be expressed by obvious natural shadow playing upon the moulded or ornamental work as a part of the colour decoration.

The colour of glossed or unglossed ceilings, or cornices, is affected by reflected light from floors, wall-surfaces, as sensitive drawing-rooms in larger houses often shew by taking a colouring from the ground, walls, or turf, or even from their opposite neighbour's domicile. These reflections, as well as the coloured neighbours in juxtaposition, lend themselves in the use of tones really different from what they appear to be, to meet what they are likely to catch, and affect, from their artificial or more natural surroundings.

Dealing with a staircase, if it is wearisome, as many of them are, its monotony may be reduced by giving it an apparent appearance of rest, repose, and stability, which may be expressed by shewing off the line of floors. If the space is contracted, horizontal interval divisions or joints will make it declare more width, breadth, and liberty. While treating cupolas, domes, or tunnelled spaces, the higher they are, the more vertical expression is required of them, and, of course, the lower they are, the less, to obtain natural architectural freedom.

Fashionable colouring may disturb the harmony of architectural features, as much as an unwise tapestry decoration or furniture selection, whereby derangement takes places for the conveyance of irritable sensations to the mind, instead of those more pleasurable when less quarrelling neighbours are avoided. Perhaps the skill and choice of an "ADEPT" should not always be ignored in these embellishments, that more harmony may be established between vulgar or unvulgar characteristics. Decoration, termed "false and show work," with needless, fanciful, stencilled imitations, or where useless carving and ornament are sought in furniture, may not be productive of comfort and utility, nor convey so happy moods to the sense and mind, as a more simple artistic treatment, graceful and harmonious, on broader natural sympathies, and less feigned tyrannical principles. As those indications or articles which are substantial, useful, and refined, are greater achievements than those which are splendid, luxurious, but vulgar, so these latter must always transmit caged, unpleasurable movements to the mind, of the power they have received, in comparison to those other which have simplicity, comfort, and beauty, or in their more enlightened expression of wisdom and liberty.

Colour affects the mood and physical health of individuals; as, for example, cheerfulness and activity may be communicated by light shades, while dark ones transmit melancholy and depression. But continual subjection to, and monotonous excess of white stimulates nervous restlessness, as black favours hypochondria. In the absence of harmonious hues, the mind is not privileged to extract that spirit of refinement conveyed by more agreeable, more natural, and happier colour-combinations. Nerves that may be animated by red, for instance, will be quietened by green, made passive by blue, as the eye may again be attracted by yellow, and a state of repose influenced by shade. The blending of *chiaroscuro* is, perhaps, the happy medium, by which colour exerts its full natural force for physical wellbeing, as well as for mental enjoyment. The trinity of colour primarily unites yellow, red, and blue into one, as that one diffuses itself into three; these again produce their complementary phenomenal halo illusions in violet, green, and orange. A beam of light from the macrocosm is decomposed by the microcosm into seven shades, from which spring endless varieties, like plants or animals, all traceable or untraceable to oneness. It is well known that the nerve fibres of brutes can either be excited or charmed by certain phases of colour, the effect of which on the propagatory life and health of plants is also very marked. Red, for instance, favours madness in some animals—a power, however, that may be turned into indifference when neutralised by opposites. The combinations of harmonious natural shades, as decomposed by the prism applied to art, if they give a cheering assurance, and possess a healing balm for physical weakness, it is improbable that that influence will be diminished for destroying many forms of mental sickness.

XIV. HINTS TO HOUSEHOLDERS.

ALTHOUGH the health and happiness, if not also the wealth, of individuals and the community, are in large measure affected by the character of their dwellings and surroundings, yet so lax are the people in the question of sanitary housing, that a pecuniary consideration in the saving of a few pounds sterling of yearly rental frequently turn many aside for an inferior article, running the risk of future ill health, and dealing in medicine. Sanitation, like other products of intelligence of the past, has at first not only to contend with these pecuniary peculiarities, but in many instances against prejudice and ignorance.

In designing arrangements and apartments, their use and furniture adaptation are too often ignored—their relationship and convenience sacrificed for obtaining some external "front"—the internal arrangement being moulded to suit the "elevation," instead of that elevation growing out of a wiser plan. The bed of the room is made to occupy a position midway between the door and a window, or between a window or door and fireplace; or the light is made to come to the bed in a position that the eye of the sleeper is opposed to, instead of the light flowing with, the line of vision. Whether people are to sleep with their heads to the north or other position more or less magnetically affected or inaffected, architecture, *it is supposed*, cannot determine, although it can assist in apportioning positions to doors, windows, and fireplaces more favourable to the comfort of those who dwell in contact with them.

If, through conventional prejudice, or a greater feeling of comfort, carpets are laid in bed-rooms, they need not always be made to cover the entire floor, but a margin of 15 to 24 inches broad—regulated by the size of the room—should be left for beeswaxing or varnishing, by which the carpet is made more portable for frequent lifting and cleaning without disturbing any heavy furniture resting on the margin, while the borders are left free for washing. Too many carpet stuffings are only retainers of dust, as closed margins are for its lodgment, where it must accumulate, to rise and fill the air of the room with every individual movement. Let not over-curtained or fusty ones, or old carpets or unclean ones, be hindrances to the flow of air, or make it impure, or shuttered windows interrupt the flow of light from heaven's gate, for the increase of medicine and physical loss.

The sanitation of householders and their homes are gaugeable as much in the appearance of themselves, as by the appearance and aroma of their domiciles. These peculiarities are not confined to the lower classes, as the following facts will testify:—

In the Western Highlands, the manse windows of a certain minister, stuffed with rags and blotched with paper-pasted panes, might speak of eccentricity, but he as well as the kirk also corresponded. These peculiarities, however, bear no index to his intelligence, but merely an indication of his sanitary propensities. Many a genius has to labour in a kirk as devoid of beautifulness as of insanitariness; and to live in a decayed manse, or one infiltrated with ground-air from a near graveyard. Such an under-current, even in the country, cannot be expected to increase either one's health or one's oracles, and it should not be wondered at if such men sometimes, even indiscriminately, seek some other stimulating relief in occasionally hawking a sermon for some other more sanitarily-situated living.

Now, with reference to disinfectants, the following paragraph is taken from the *Lancet's* editorial:—

> Great harm has been done by the popular recourse to so-called "disinfectants," which are, in fact, only stink-destroyers or disguisers. Nothing is gained by making the odour of sewer gas less offensive than it would otherwise be. It is not the "smell" that does harm, though it may nauseate; this is a small matter. Poisoning by sewer gas which has been disguised or deprived of its characteristic smell is, we believe, the cause of many unrecognised maladies. The evil influence against which we need to protect ourselves is a gas or vapour laden with the products of disease, which are nearly always, if the late William Budd was right, desiccated ova or seeds, requiring only a warm and moist place in some living body to vitalise and fructify. It is a beneficent provision of Nature that poisonous or poison-carrying gases or vapours generally have an offensive smell. We destroy the warning odour, without destroying the poison it denotes. We take the rattle off the tail of the snake that he may the better bite us with impunity. Deodorisers, which are not also destroyers of all organic materials, are mischievous, and their use militates against the health of the people.

Disinfectants and deodorants, perhaps, cannot have the same effect in destroying organic materials as air made perfectly irrespirable, yet they in many instances possess a temporary value. The use of chlorates or muriates are corrosive and destructive to iron and lead soil-pipes, brass and other mountings. Their immediate virtue is small, measured by their ultimate perforationary action, when continued on many internal house-fittings. Circulation of air, moving copiously in the sewers, with sufficient water-flush, are their undoubted disinfectants.

TURPENTINE (distilled resin of fir trees) and CHLORINE (lime saturated with a gas resembling sulphur) are deodorants and disinfectants, the latter being, however, more a deodorant for earth-closets; while it changes bad smells, it also destroys organic substances. Chlorine corrodes metals and destroys colour, but, where it can be freely used, is a valuable disinfectant, especially during epidemics. Then there is a crude carbolic liquid acid, used for drains and sinks, which has little action on metals; a finer quality being employed for lotion and ablution purposes; a finer still is made for purifying the human engine.

Clothes from the sick, instead of inadvertently being allowed too often to lie past, should be immediately plunged into water containing a suitable proportion of such a disinfectant as carbolic acid. Without such precaution, infectious or contagious ingredients are more readily conveyed to those coming in their contact, or with other people's clothes in public laundries—which is a mistake—being mixed with them.

EUCALYPTUS (globulus), extracted from the Australian pine tree, possesses a value in making the air of the room agreeable; besides being a disinfectant, it assists in purifying the air of a sick-room.

"GASOLINE, the product of petroleum, although it has little power over gases, yet when applied to plants or sores (to the possessors of which, while being harmless and painless), is effectual in killing insects and all low forms of life. Letters or articles for transmission by post, or passing from hand to hand, may be disinfected by it without stain, and it evaporates so rapidly that articles so touched dry in a few minutes."

MANGANATE OF SODA and SULPHATE OF MAGNESIA (Salts), in their combination, give off OZONE; the former is applied, in the form of Condy's Fluid, to internal soil-pipes and sick-rooms. As will be seen in the Appendix, CHLORALUM is a useful non-poisonous disinfectant, applicable and harmless for many purposes in a household.

If there be any suspicion of sewer-air gaining access to an apartment, it may be detected by simply dipping white sensitive blotting-paper into sugar of lead; and after exposure for a time in the room, if sewer gas be present, the blotting-paper will gradually become black. The air of a room, *Health* says, may also be analysed in the following manner:—An 8-oz. bottle is stuffed with a cloth before going into the apartment, all openings of the space, such as chimney, window, and door having been previously closed for a time; and having entered and shut the door, the cloth is removed from the bottle in the closed room *with a bang*, the air in the room at once rushing into the bottle; then from a sealed vessel add a half ounce of lime-water, which will remain clear if the air is good—if bad, the liquid will assume a milky colour.

Water may be similarly tested, by filling a clear bottle with water half full, adding some Condy's Fluid; after which, if the water assumes a beautiful purple colour, there is reason to believe it is wholesome; but if it becomes of a brown tinge, it is suspicious, as the fluid has the effect of burning the bad matter—hence the brown hue. Hard water is not infrequently a bugbear in the washing of clothes, and it is well to know that it may be considerably softened by passage through lime, by boiling, or by exposure.

THOSE RENTING A HOUSE are supposed to avoid "a low-lying district, near standing water, marsh, outlet of sewer, river, or offensive works; near any offensive accumulation, ground forced by offensive matter, or too closely related to a middenstead or privy.

"A house below the surface of the ground, in the form of a cellar or basement, bedrooms without fire-places, rooms without windows, or windows that do not open.

"A house whose cistern supplies both water-closet and water for domestic cooking, where the landlord will not make a separate supply direct off the 'main,' where the water-closet is in the centre of the interior, or where the landlord will not ventilate and light it, if without air and light, should also be avoided."

Where possible, get the water-closet against an external wall, in an offshoot, or outside of the house, and wherever situated, well lighted and aired.

Have all gas, water, drains, and pipe attachments tested once a year, and always before occupancy.

THOSE OCCUPYING A HOUSE are expected to have continuous ventilation in staircases, lobbies, water-closets, etc.; all rooms ventilated, if not permanently, at least partially. If a chimney smoke, see that the want of fresh air to the room or a foul vent is not the cause, or an iron "register" grate instead of a brick "Kinnaird" one, and always use smoke-consuming and heat-retainers for the fire.

See that all sinks and water-closets are water-flushed at least once a week, watch partial smells, and do not allow permanent ones to persist. Prevent vegetable or other offensive matter remaining long in dust-bins or ash-pits near the house, and have a cinder-separator attached for saving fuel for fire-backing.

Look to the water used for cooking, see that it is not from a stagnant source, or well, reachable by middensteads, and do not use water for cooking purposes from a corroded or any range boiler.

Have house drains and soil-pipes disconnected from sewers, and air circulated in them independent of house air.

Have no gas light, or fixed wash-basins with drain attachments in bed rooms; coat walls with hard, porous, washable colours; watch the use of wall-paper for poisonous ingredients, and see that it is obtained from known manufacturers, guaranteed free from poisonous ingredients, and that it is stuck on with carbolicised paste, and always varnish the natural internal wood instead of painting it.

THOSE BUILDING A HOUSE should select an elevated, sheltered locality, with cheerful surroundings and pleasant prospect, avoiding an eastern exposure, and seek a site dry and gravelly.

Place the axis of the building and windows therein for the most sun-access to the interior all the year round.

Have a high ground-floor level, and, if possible, avoid basements; ventilate area underneath between floor and ground-surface, and put felt or asphalte round all walls at surface, to prevent damp rising any further; and do not allow sea-sand to be used in building, as it makes the walls always damp. Have water-closets, etc., in offshoots disconnected and ventilated independent of house with EARTHENWARE instead of lead cesspools, and smooth or tiled wall surfaces instead of rough ones for cleanliness.

Build high chimney stalks, as they increase draught and prevent smoky vents; insert grates, as already stated, with brick heat-saving enclosures and smoke consumers. Have all places ventilated by air inflowing and outflowing spaces, and attach AIR-PUMP VENTILATORS to the latter.

Have portable means of access to all gas, water, and drain fittings; provide for window blinds to fall clear of sashes, also for window hangings, that their poles will not hide the room cornice, but the cornice made to advance by means of a soffit, to which the pole in the case of projecting windows will attach itself; and see that necessary windows open for cleaning, as well as for air admission.

Always put on substantial IRONMONGERY, and the best material of everything, however plain, as the best is always the most profitable and cheapest in the end. Guard the premises with a malleable-iron railing in preference to a cast-iron one, as the former is tough, the latter brittle and easily broken.

Have the green, if possible, where it can be overlooked from the laundry, and where it can obtain most air and sunshine. In laying out grounds, plant in clumps, leaving plain surfaces for contrast and variety. The same principle applies to the spacing of windows, massing and inter-relieving the formations of walls and roofs, and their minor details.

Lighting and heating appliances, picture rods, window blinds, and such like, should all be fixtures; as the taking of them down and refitment by change of occupants always more or less destroys the amenity of the interior.

Dr. Richardson thus remarks:—

> Let every man and wife be their own sanitarians, and make their house a centre of sanitation. Let in the sun; keep out the damp; separate the house from the earth beneath; connect the house with the air above; once, nay twice, a-year hold the Jewish Passover, and allow no leaven of disease to remain in any corner or crevice; let the house cleanse itself of all impurities as they are produced; eat no unclean thing; come back to the first fruits of the earth for food; drink no impure drink; wear no impure clothing; do no impure act; and all the good that science can render you is at your absolute command. I say nothing but what is good of physical exercise; I would that every school were a gymnasium; I would that every man and woman could ride well, walk well, and skilfully exercise every sense and every limb. I urge only that this example be set: that all exercises, whether of body or mind, be carried out in purest habitude, and in accordance with the enlightening progress of the age.

XV. EDUCATION AND LEGISLATION.

A CHILD is obliged to attend school, and the parents liable to be fined, if able, and failing to educate their offspring, which is so far good; but the child's home is not less worthy, if not more worthy, of attention. If the importation of knowledge cleans the child's mind, his home must also correspond in the possession of sanitariness; otherwise, however clean he may be made by teacher, by book, or contact with his fellows, he will always return to "wallow" in his home, and lose much of the cleanness bestowed upon him. Besides, each child is a radiator of the cleanliness or dirtiness, the good or evil, a carrier and diffuser of vice or disease, of that home (which may be asleep or awake), to its inferiors, superiors, or equals. The sanitariness, therefore, of the child's home cannot be less important for the public weal than the watchfulness of the nation's food supply, the movements of graziers' stock, or the *gauging* of distillers' maltings, for the purse of the Exchequer. When the child has satisfied the State as to his age and acquirements, he is allowed to enter a factory or workshop, where the hours of his labour are restricted and inspected, without virtually any further substantial testing of the wholesomeness of the air he is obliged to breathe in that particular space or sphere. "A nation's health being a nation's wealth," if that health is impaired by unsanitary worshops or homes, sickness and pauperism will further spring up, as they have already sprung up, and, in their train, tax-eaters such as poor-houses, hospitals, and prisons will not decrease.

The personal practice of that which is next to godliness cannot, it is supposed, be enforced by legislation, but it can be encouraged, and the principles of personal and household hygiene made a part of every child's school training, without which no great reform in this direction can ever be expected from adult culture. As women have the closest relationship with the house, the training of girls in those principles in the practice of which depend the comfort of everyday life will, at all events, assist in preparing them for being better future wives, as a knowledge of sickness, accidents, or what to do in emergencies will make them better mothers, or the learning of useful or other domestic accomplishments will tend to make them stricter economists—more within the limits of their husband's purse—in the management of the household.

There is a clear relationship between uncomfortable and ill-ventilated homes, with preventible disease, and the craving they stimulate for intoxicating drink. The well-being of the nation is so intimately associated with its health, that education and sanitation are inseparable, and their legislation barren of greater achievements, in so far as it is incapable of wisely emulsifying and concentrating these twin powers. Legislative doctrine is not unlike some theological dogmas, both being naturally governed by public opinion, usefully or unusefully serving the age, so long as the people are benefited by them: lapsing when outgrown by higher forms of truth. In like manner, sanitary condension and refusion, moulded by the experience of the past, cannot but be forthcoming in a PUBLIC MEASURE fraught with the necessities of the present, which have grown out of that past, in lessening contentious inequalities between municipal and rural areas, so disadvantageous to sanitation.

IN THE PAST, towns have expanded and sprung up without any defined or comprehensive plan to meet existing or future requirements; air has not been allowed to flow in on all sides, but, wherever possible, it has been cribbed, and interrupted by narrow alleys, and congeries of dense reeking structures. Without any plan or compass, authorities, generally speaking, have been, as they are still, groping in the dark. There has been too little premeditated system; and when order is thus unconsidered and wanting, confusion reigns in its stead. The helm of the *terra firma* ship for guiding authorities and captains cannot, therefore, be too soon steered in the proper direction for the interest of the community, and encouragement of more sanitary dwellings. In certain classes of domiciles improvements may be effected, and the constructional ignorance of the past altered for the enlightenment that ignorance has conveyed to the present; but it is only in the demolition of rotten, reeking fabrics, or overcrowded, unhealthy areas, that hot-beds and radiating centres of disease can be rooted out, and mitigated by more ærial preconceived sanitary abodes.

The bodily health and home culture of the people being thus largely affected by domiciliation, the work of the jerry builder and others in these erections is not incomparable with a manufacturer or merchant palming unwholesome food upon those who may be good enough to patronise him. Every unsanitary house allowed to be erected means, therefore, so much more disease to its inhabitants, and a degree of indirect, but ultimate, tax upon the nation. Then, again, those prime operators who design, superintend, or are speculating builders of domiciliation, are, according to present enactments, neither controlled by diploma nor license, by which the most ignorant of sanitation may erect a house, not at present a nuisance within the meaning of the Act, but which, from the character of its arrangement, is certain to become unhealthy; and there it is, a disease-breeder and secret poisoner for all by whom it may be *bought* or *brought* in contact.

Sanitary design and arrangement undoubtedly require a special train of thought; and no man is surely better able to receive, combine, and transmit that knowledge than a graduated, diplomatised individual. An architect, the *alpha* and *omega* of house building, on whose knowledge the sanitarily-arranged connections of the dwelling depend, is surely not less controllable by licence, or otherwise, than the auctioneer.

The provision for "prevention, which is better than cure," is too lax, whereby an ill-construction and arrangement are allowed to take place, out of which evils are sure to arise, which, when they arise out of conditions favourable to their production, are attempted to be cured when they should have been primarily prevented.

Regarding the appointment of sanitary officials, too many of them have never received any special training for sanitary work; besides, the miserable emolument generally afforded by Authorities cannot induce trained men to risk their life with sanitary inspection. They have, besides, much to contend with in virtue of their appointment, being directly under provincial authorities; these authorities being frequently large property owners, and if his duty demands a condemnation of some particular property, an indirect antagonistic influence is at once set in motion, whereby his position is trammelled, and the law gradually becomes disregarded. Were a Department formed, devoting itself to sanitary affairs, it would become possessed of an Inspector-General and District Overseers, under whom there would be highly-qualified and independent men, *sans reproche*, who would, perhaps, operate more beneficially on public and domestic sanitation. THIS COUNCIL would watch the *Times* for the order of towns and dwellings; plans, showing public and domestic sanitary arrangements would be filed; healthy and unhealthy houses notified, distinguished, registered or certified; prime operators (architects) diplomised; contractors and plumbers licensed (adopted in New York); registering and certifying inspectors, etc., by which *red-tapeism* would not perhaps be decreased; but if it increased ventilation and encouraged enclosed spaces, public and private, to receive a due amount of inflowing and outflowing air currents; controlled building arrangements, conveniences, and drains; watched water supplies; assisted the abatement of smoke for the cleansing of the air of towns, or reduced the return of noxious substances from streams or other sources to the citizens, more cleanliness, less disease and pauperism, to which may be added drunkenness, much good would perhaps at last, aha! result. It is notorious that, for the want of, or uniformity of, or enforcement of, sanitary law and order, many rural districts are as wretched as some of the filthiest slums in cities. In these ruralities, every individual and householder are a law unto themselves, where they have a pigstye against the outer wall of the dwelling, into which a window looks—which is not so bad as when the byre is "but and ben"—to be seen amongst and surrounded by the most enchanting natural scenery, as if lending to it the beauty of contrast, or something for the artist to employ his brush on.

At a conference in Glasgow lately, Dr. Russell said:—"The principal towns only, which embraced one-third of the entire population, had reduced their death-rate to a point at which it stood 20 years ago. Comparing the last two periods of ten years, the principal towns had reduced their death-rate 7·6 per cent.; the large towns, scarcely ½ per cent.; the small towns, 5·8 per cent.; and, on the other hand, the *rural districts*, which comprised another third of the entire population, actually had in the last ten years a mortality 4½ *per cent. higher* than they had 25 years ago, and precisely what they had in the preceding ten years." He also shewed that "the death-rate from diphtheria was actually higher in those rural districts than in many of the dense and overcrowded principal towns, and if one took a standard of comparison—viz., the proportion which these eminently preventible diseases contributed to the total mortality—it was in both cases enormously greater in the rural districts, derived from the average of the last ten years."

It occurs partially in this way (in Scotland at least), that the administration of the Public Health Act in the rural districts is entrusted to Parochial Boards, who, like their Central Authority, are more or less stagnant, and rather retrograding in their movements. Any worn-out policeman or shopman is considered an important official for a sanitary inspector, if he is capable of *winking* at unsanitary conditions. Those composing local boards have sometimes property in a questionable sanitary state; besides, many of these members are merchants who care not to meddle, or to enforce any meddling of their servant regarding the curiosities or habits of their patron clients.

With the most complete sanitary arrangement and perfect construction, people, it is *supposed, will still die;* but their life may be made more cheerful, prolonged, unhappy, or shortened, according to the degree of sanitation and peculiarities of treatment they may be more or less exposed to in their housing and surroundings. Until, therefore, a SANITARY HOUSE is shaped generally into some degree of conformity with natural laws, more regulated and supervised, and more uniform legislation between urban, rural, and all districts, in the future than in the present, animal life necessarily cannot be less TAXED, but must be much more TAXED in settling heavier bills of suffering, disease, and death. At all events, public and domestic sanitation would be brought under such order as to ensure, at least, a condition more favourable to health, and consequently to the sum of human happiness, alas! at present sadly awanting in the balance of well-being.

The office of SURVEYOR for a municipality, whose partial duty is to report on all proposed plans of new or altered buildings, is no more paradisiacal than the charge of a SANITARY BROTHER. In many instances, however, these offices are combined, and, like other kindred appointments, are salaried off the public rates, under a fast and loose understanding that the official devotes his whole time to the duties of his office and business of the Trust or union of Trusts. But ere long this dignitary has his high moral principles disturbed by some of the more beggarly members of the Board (under whom he labours), his masters, and their friends. Documents are required for some alterations on their trading premises, a new or enlarged abode, whereby the services of an already-harassed officer are smuggled into requisition, the refusal of which would at once imperil the harmony of his public service, and for this work he pockets a fractional "gratuity." A "bone" is thus thrown directly in the teeth of this public servant, which engages his attention while "irregularities" are being smoothed, and any dutious "surliness" that would be caused by "deviations" is changed into indifference. These "tips," whatever their value to their victim or gain to his ruler, are decidedly demoralising to both; as the labour for which they favour is more or less a public loss, consequently a polite means of causing the embezzlement, perhaps, not of stationery or money, but of time, which is the equivalent of money. By reason of these infringements the public interest clearly suffers, details are neglected, public jobs are prolonged, workmen are left to themselves, and work performed has not unfrequently to be re-performed, because the time for the necessary forethought has been otherwise absorbed and appropriated, and that energy which should have been committed to the work of the PUBLIC is frittered away in serving the interest of private parties. How true it is that "the public are always ill served, but never know how to get better served. Faults and virtues generally grow up side by side in daylight, with no apparent outward difference, yet the former always leave a sting which afterwards gives pain and trouble." "Religion, morals, law, rank, connections, custom, all rule only the surface of city existence. The streets, bordered by splendid houses, are kept neat, and every one behaves himself there properly enough; but indoors it often seems only so much the more disordered, and a smooth exterior, like a thin coat of mortar, plasters over many a rotten wall, that tumbles together overnight, and produces an effect the more frightful as it comes into the midst of a condition of repose." Restriction has such a peculiar charm on the mutability and morality of human combinations, that an enactment is no sooner introduced than device antagonistic craftily begins to move for its evasion, by which a continual want must ever be created for new measures. In this way, although the work of the legislator is not depreciated, but increased by the ratio of the nation's diversities, he will always have the power to flatter himself or an opposite neighbour, while performing a silvern or golden duty to his country. At the same time, his invisible power is liable to suffer curtailment, if not governed by the growth of the intelligence of the people whom he slavishly or unslavishly serves.

At the "building of Babel" men were found acting the riddle of human life then as at the present day. Individuals at that time deeply interested themselves in the affairs of the Tower, and sat, it is believed, at its Council Board, who were actually sleeping partners in firms doing work for the Trust. Contracts had also to be manœuvred, of sections of the work, for the benefit of their partners, until "jobbery" and "gifts" became perfectly intolerable. "People could not at the same time be happy and wise, numerous and united; their tongues were confounded, the men were dispersed, the world was peopled, but sundered, so that minute traces of paradise were not to be looked for after so great a revolution."

When a STREAM has to be re-bridged to cope with the time and increase of traffic, by which the public weal is extended, and yet preserve the "auld brig," it has to contend with "the poorest and most insignificant" of ancient PIERS, however dwarfish they may be, ere it can clear itself of these encumbrances. Such impediments in the opposition they afford may be necessary, provided they are drawn from useful, not necessarily from hereditary and ornamental sources, and support and do not overburden practical labour and industry. On the other hand a surmounted ornamental PIER attachment may be useful for looking at, but, when used merely as an ornament, if it does not favour cohesion, dignity, and wisdom, may result in producing not only a weaker, but probably a more expensive commodity.

The repair of any ancient curiosity, no doubt, husbands its lingering strength for a time, but soon again parts are disintegrated, and expense and waste with them are increased, the supports gradually become disordered by overburden, until at last the Keystone itself gets ousted and falls from the higher office it inherited, or for which it was created.

XVI. THE POOR AND THEIR DOMICILIATION.

NOT so long ago as 1826 Edinburgh was, as other like towns at that time were, sadly deficient in their sanitary acquirement, when "stool-men" patrolled the streets, carrying portable conveniences, calling "Who wants me?" At that time it was, as it still is customary in many of the Eastern cities, for persons to throw out refuse from their upper house windows to the street with a shout, "Votre chapeau guard, Monsieur!" or at home, "Mind yoursel'!" sometimes to be answered by a hurrying pedestrian, "Haud yer hand a wee." When water-closets came to be introduced, and street and house middens abolished, which largely occupied every "cut and turn" of houses and their surroundings, the equanimity of housewives was not unruffled in meeting opposing and improving authorities with "'Deed, sir, you may tak' oor lives, but spare oor middens." There were both truth and ignorance in the remark, as with the introduction of internal water-closets and sealed drainage communications, disease germs sprung up, as they still spring from, or are nursed in, hidden, unventilated spaces. The former deficiencies produced plagues, black deaths, and cholera, by which the people were intermittently thinned by hundreds of thousands. But the people came to be inoculated, and greater cleanliness prevailed, by which the plagues were alleviated; yet sewer poisons and overcrowding awakened their equivalent by more constant and less intermittent forms of disease.

In early times families gathered themselves together into tents, occupied encampments (as they still do in uncivilized parts), erected lake dwellings, and built themselves mud cabins. Humanity was the same then as it now is, only knowledge has increased, and with it, shall we say, physical weakness? But mud huts are not yet departed from the Highlands and Islands of Scotland or Ireland. There are country hovels severally, and congeries conjointly, on a par with town slums much inferior to the average of cattle-stalls. Speaking roundly, 10 per cent. of the houses occupied in Scotland are without windows, nearly a third of all the houses are of one room, while a twentieth part of them have six or seven persons occupying one room, and in many instances from seven to twelve persons to one apartment, and that one room unfit in any sense for human habitation. In these circumstances, there can be neither decency nor privacy, for the advancement of morality or the cultivation of self-respect, but by their cheerlessness and uncomfortableness, a natural craving is created in them for a more inviting beerhouse. Means are thereby expended on intoxicants, on other indulgencies, and low-toned amusements, by which the family suffer in hunger and nakedness, so that nothing is saved for sickness or old age. Drink thus takes root in depraved domiciliation. While its consumpt reduces income taxes (which are a mistake), it again increases parochial rates and pauperism (perhaps another rated mistake). The outlay on intoxicating liquors in the United Kingdom, a great part of which is not unsavable, is not far short of £136,000,000 annually for the last ten years, equal to £4 for each man, woman, and child, or £22 for each family of 5½ persons. The outlay on intoxicating liquors is also equal to the entire outlay on house rents and bread (excluding farm rents), or to the total outlay on butter, cheese, milk, sugar, tea, coffee, cocoa, household coal, and education—or to bread, raw raiment, and farm rents.

The poor have to be educated, housed, and fed on rates, these alms being as demoralising on the lower classes in their scope as income taxation is on the higher classes—both undoubtedly antagonistic to the higher influences of nature and morality. Caged birds must either be fed or they die, but give them liberty, and they feed themselves. (The insane or imbecile poor are not here meant, who must always be more or less provided for.) There is no reason why the poor in great measure should not be obliged to feed upon themselves, drawn from a Common National Assurance Sustentation Fund, into which every person at the age of 21 has been compelled to lodge a "stake."

The children of the people are now required to be educated. Rightly so. They might as well be drilled into provision for sickness, old age, and against their becoming vulgar, or MORE GENTEEL PAUPERS ON THE COUNTRY. The greater "elevation" of "the poor with us always" would also tend to their decrease by drawing interest from their own fund, instead of their liberty and tone being reduced by national-rated alms.

In dealing with a malady, vigilance becomes all the more necessary that the evil is not intensified. Unless the poor can generally be piloted by economical machinery on self-supporting principles, the honest and industrious are harassed, if not reduced to a degree of pauperism, especially if saddled with burdens which cannot be lightened, when regulated by much that is perverse, in the absence of more simple and less expensive administration. The melioration of people confined within the narrow limit of densities will necessitate a thinning, as well as a spreading over the land, if the current of enlightenment gradually being forced upon them is to be strengthened, while reaching dark places, in demolishing their hovels, and avoiding congestion of other parts. Pioneers, if not frightened are perhaps awed by obscurity, and life is generally so much the less secure in those "chequered day and night" regions, where the sowing of education is always performed amid a crowd of difficulties. While light dispels the mist enveloping those places, air exerts itself against disease germination, as draughts of labourers from the town to the country, instead of *vice versa*, favour that expanded independence of character, so destructive of lower forms of life. It is also observable that the less constant cultivation becomes, the more readily is the return to that condition prescribed by nature.

There are a class of destitute poor—made so by sickness, want of work, drunkenness, contact with unhealthy slums, and laziness—who, in their present helpless condition, can do nothing for themselves, and who require to have a scheme of Work, Housing, and ASSISTED EMIGRATION wisely instituted for them. They must be drilled into work, absorbed by colonies requiring labour, and those at home drafted into more sanitary abodes. These abodes must also be self-contained, capable of being let in one, two, or more apartments, and provided always with common baths. Each large block of building would also have a pensioned superintendent; a watchman, whose duty would be to guard the property, having also an eye on all suspicious or unsuspicious-looking individuals. As certain classes destroy property, a watchman, while he looked after the interest of the fabric and regulated cleanliness, would always be a person accessible for information in the detection of crime, if he did not tend to influence its prevention, at least in so far as the destruction of the property would be concerned.

Buildings, whether erected by public enterprise, national available savings, or private adventure, should be constructed on plain, neat, economical principles, favourable to an easy rent. These would rear themselves simultaneously with displacements, for the evasion of overcrowding of other parts, as well as in a wise provision against their future overcrowding. These prime philanthropic movements in the destruction of disease-dissemination, cribbed streets, and hovels, if they operate for the reduction of sickness, pauperism, and crime, would surely not be without interest.

There is that other class, including artizans, who can club together, and, by the strength of union, become occupiers of their own houses, with little more yearly outlay than they pay as rent. In 14 or 15 years' time the house becomes their own. Investment Building Societies and Assurance Companies have already aided, as they are still ready to aid, men to obtain homes of their own. Those who have converted their rent into capital or house-purchase payments, are possessed of homes to-day, who would have been no further advanced had they continued paying rent. The co-operative club or society receive the payments, extending over a shorter or longer number of years, to suit the varied circumstances of individuals, and act on the footing of bondholders, by being infeft in the subjects until the property is clear of debt. Such a proceeding is next to Assurance forethought against sickness or old age, by which people gain in return more felicity, a stake in the country, and also the "freedom and glorious privilege of being independent." The greater part of the money of the country floats amongst the working classes. It passes through their hands, a proportion of which they can and should save, for the independence of themselves, as well as for the interest of the nation. The large amount of investments lodged in Savings Banks shew that many are not thriftless, the interest accruing to the lenders being 2 to 3 per cent. But were the working classes to invest in houses for themselves, the interest, instead of being 2 to 3 per cent., would at least be 5 to 6 per cent.—exactly doubled by becoming their own bankers. The scheme on which the co-operative movement hangs is a "sliding scale," to suit migratory or stationary persons, by which the property, in the event of a change taking place, is made to revert to the society, or is transferred to another person at a price in proportion to its redeemed value. In wise constitution and profitable united investment of savings, the people have power to benefit themselves. But it is only by co-operation that working men have strength; single-handed they are powerless. By unity, by discriminating and discretionary management, their co-operation is as capable of expansion for a landed backbone investment as for a domiciled interest, and not less manageable than a post-office or a railway system. The development of domiciled possessions, while circulating intelligence, creates thrift, and vies, not only for the social improvement of individuals and their fellows, but in the broader interwoven interest of the nation. Improvement has to begin at "home," by which it is expected to run outwards. Let not intoxicating drink be driven inwards, to become an internal canker, by forced, feigned, or apparent teetotalism. Strong drink is a medicine, perhaps a necessity, and only is its misuse to be deprecated. There is a taste in human nature for luxuries and sociality that amounts to worship, which, if not gratified by light wine and beer, or more felicitous home allurements, or pampered by other curiosities in moderation, a less sobrious crop will not so readily be cultivated. The accumulation of suppressed force is also in danger of causing a greater eruption, like the debouch of a volcano after a period of internal slumber, which the more wildly opens its *fearful jaws*, projecting an excess of long-unused wrath, and petrified fiery demons, hissing with delight as they escape and carry destruction from their awful entombment. Fortified cannons begin to leave their place, utensils dash against each other, the earth rumbles, the air quakes, land and sea heave and are smitten together, objects are obscured by the greater heat, parts of lands and houses disappear in company; but in the midst of all this confusion, while nature is active and devouring, pain and pleasure present themselves, for vagabonds are on the alert, pillage is rampant, there is loss on all sides, the balance of power is gradually restored, and nature is again appeased. As *babes* require milk, weak people should always abstain, and avoid even the *guff of a distillery* or public-house; but *strong men* will always govern themselves, and drink "even for their stomach's sake." Yet the accomplishment of good work, as it was, is now, and ever shall be, must be achieved by those temperate mortals who mostly drink water.

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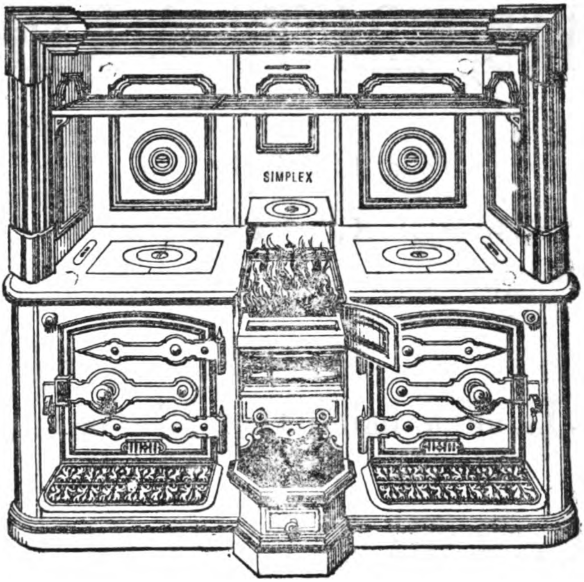

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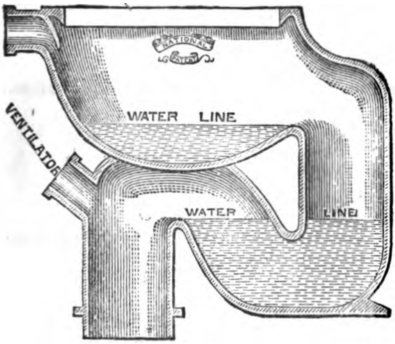

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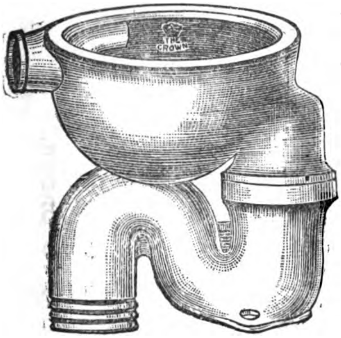

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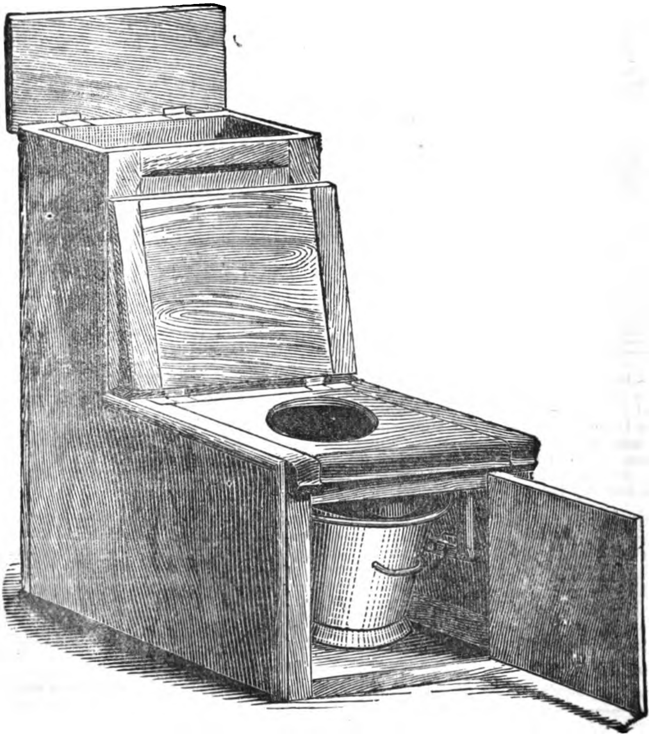
&c., &c.

"Thou shalt not pollute rivers or watercourses."—Mosaic Tradition.



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STEREOTYPE FOUNDERS.

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BELL'S ASBESTOS FOR FIRE-PROOFING.

BELL'S ASBESTOS PAINT,

FOR FLOORS, STAIRS, & ALL INTERIOR WOODWORK, to PREVENT the SPREAD of FIRE.

THIS Paint is especially useful in Cotton Mills, and, in fact, in all Factories and Buildings exposed to risk from Fire.

It is quite free from poisonous ingredients, and is both easily and cheaply applied.

Bell's Asbestos Paint has on several occasions done great service in preventing the loss of life and property. The great fire in Buchanan Street, Glasgow, in November last, produced the following testimony to the value of this material:—

Offices of "The Glasgow Herald," "The Weekly Herald,"
and "The Evening Times,"
GLASGOW, 14th November, 1883.

SIR,—As one of the means which helped to save our Buildings—extending from Buchanan Street to Mitchell Street—from the recent great Fire, I think it fair to say that your Asbestos Paint, which was applied to the outside hoist of the "Evening Times" Case-Room and other portions, gave valuable proof that it materially aided in resisting the flames from the immediately adjoining tenement, while the Fire was rapidly destroying it and threatening us in the most serious form.

Since the Fire, and to assure myself further of the value of the ASBESTOS PAINT as a Fire-resister, I placed a piece of wood with your Paint "put on" more correctly than in our case into one of our furnaces, with the result that it was brought out without a fibre of the wood being touched, while similar pieces of wood thrice coated with Irish Lime at once got into a flame.—Yours truly,

(Signed) ALEXR. SINCLAIR.

JOHN BELL, Esq., Asbestos Manufacturer,
11 and 13 St. Vincent Place, Glasgow.

BELL'S ASBESTOS FLOORING FELT.

This article is manufactured from specially-prepared Asbestos fibre, and by its use any building can be rendered comparatively fire-proof at a very small cost. This material should be used as a substitute for brown paper under the carpet, and it can be taken up and re-laid as often as required; it may be laid between the flooring boards, on the ceiling before plastering, and on the walls. Doors of pine or other wood should be so constructed as to have a sheet of the felt in the centre, so that either side being burned the other remains intact. In houses so protected fires would be localized to the rooms in which they originate. Asbestos Felt, being a non-conductor of heat, is superior to any other sheathing, and used under slates has no equal. It yields no dust, lies quite flat, is soft to the tread, and its low cost places it within the reach of everybody.

Made in Rolls of 36 inches wide. Price, 1s. 3d. per yard.

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Asbestos Works,
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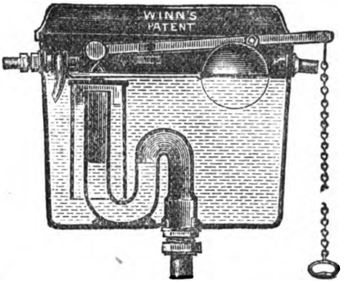
WINN'S PATENT

"ACME" SYPHON CISTERN.

PATENTED IN GREAT BRITAIN.



PATENTED IN AMERICA.

No. 1163.

ACTION AS FOLLOWS:-

By pulling the lever the cap is raised and the syphon charged, when the lever may be instantly released, as the water will continue to run till the Cistern is empty, the velocity of the flush INCREASING to the end of the discharge.

Any given quantity of Water (usually Two Gallons) is used at each flush—NEITHER MORE NOR LESS—thus economising and preventing waste of Water, and at the same time ensuring an efficient flushing of the Closet.

Apart from the Ball Valve, as will be seen by the Drawing, there are absolutely no Valves, Leather Rubbers, or Joints to wear away or get out of order.

Price as drawn, 20s. Galvanized, 28s.

Approved and authorised for use by the Birmingham Water Works Authorities, and by all the London and leading Provincial Companies; also now largely used in Barracks, Post-Offices, Workhouses, and Her Majesty's Prisons throughout the country, and adopted by the leading Railway Companies, while more than twelve thousand have been sold to the trade.

This flushing-box is suitable for any flushing-rim basin, but especially for Winn's Improved "Free-flushing" Basin and Trap, which has been designed to meet the want now generally felt for a good clean flushing pan and trap constructed upon modern principles at a moderate cost, the price being 13s. 6d. for Cane and White, and 17s. 6d. for Cane colour outside and Ornamental Flower Ivy inside—a better quality of a larger size, in superior Porcelain, being 20s. White and 25s. Ornamental.

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MANUFACTURERS OF SANITARY APPLIANCES,

Patentees, Engineers, and General Metal Workers, Contractors to the English Government for the India Office, Admiralty, Home Office, Prisons, and other Departments.

Manufacturers of every description of Plumbers' Brass Work, Closets, Pumps and Steam Fittings, Drilling Machines, Steam Pumps, Screwing Machines, High-pressure Screw Down Valve and Sluice Cocks, High-class Chandeliers, Hall Lamps and Lanterns, Gas Fittings, in Artistic Designs, for Domestic and Ecclesiastical purposes.

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Direct Acting Hydraulic Passenger Lifts with Water Balance,

DISPENSING WITH OVERHEAD GEARING, CHAINS, AND BALANCE WEIGHT.

ABSOLUTE SAFETY.

Full Particulars on Application—

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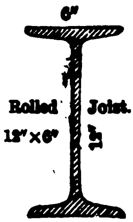
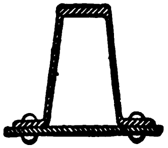


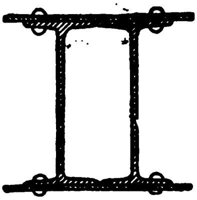
Have always a Large Stock in their Iron Warehouse of the following Sections of Rolled Joists and Flitch Plates:—

ROLLED JOISTS UP TO 32 FEET LONG.

4 × 2½ in.	8 lbs. per ft.		9½ × 4½ in.	28 lbs. per ft.	
5 × 3 in.	13	"	10 × 5 in.	36	"
5 × 4½ in.	23	"	10 × 6 in.	46	"
6 × 3 in.	14	"	12 × 5 in.	42	"
6 × 5 in.	27	"	12 × 6 in.	56	"
7 × 3½ in.	27	"	14 × 6 in.	60	"
8 × 5 in.	29	"			

Flitch Plates, 5" to 12"×½" thick up to 32 ft. long. Zorés Joists, 6½", 7", and 8" up to 32 ft. long.





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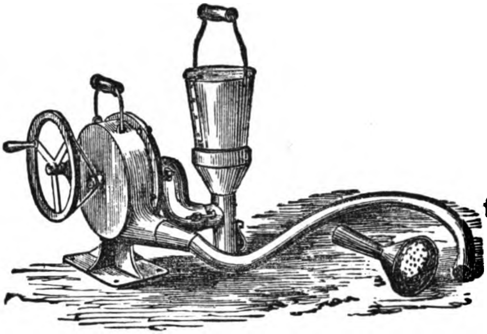
Iron Merchants and Wholesale Ironmongers.

Established 1802.

Railway Siding, **LEITH WALK STATION,** N.B. Ry., into our Yard.

THE PATENT ASPHYXIATOR.

For Applying the Smoke Test to Defective Drains.



For Fumigating Greenhouses and Disinfecting Rooms, Bedding, Clothes, &c.

The ASPHYXIATOR is now universally used for applying the smoke test to drains. The Machine has also been adopted by most of the Sanitary Authorities, Sanitary Associations, Unions, and Medical Officers of Health in the Kingdom, for disinfecting purposes.

TESTIMONIAL.

PLYMOUTH, 31st December, 1883.

DEAR SIRS,—I have much pleasure in adding my testimony to the great value of your Patent Asphyxiator as a means for testing drains. All new drains laid down in this Borough have now to be tested by the injection of smoke before they are allowed to be covered in.—Yours truly, HENRY GREENWAY, Medical Officer of Health.

To Messrs. JOHN WATTS & Co., Bristol.

PRICE OF MACHINE, COMPLETE, £2 15s.

Descriptive Circular, with full Instructions and Price List of Fumigating Materials, Post Free on application to the Manufacturers,

JOHN WATTS & CO., Broad Weir Works, Bristol.

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CHLORALUM POWDER should be used in Stables, Drains, Refuse Heaps, &c.

CHLORALUM WOOL is a powerful Styptic, and rapidly disinfects and cures idle and festering wounds.

CHLORALUM TOOTH-POWDER is wonderfully effective in removing Tartar, and is a pleasant and powerful Tonic to the Gums. All should use it.

CHLORALINE is a most valuable liniment. Three applications a day copiously rubbed in will cure the worst Chilblain in three days. A powerful astringent lotion.

ABSORBENT WOOL absorbs liquid like a sponge. May be used with any dressing.

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Every description of Fire-Clay Goods of the most Superior Quality.

They also manufacture, at THE PAISLEY SANITARY EARTHENWARE WORKS, PAISLEY, every description of Sanitary and Plumbers' Earthenware, including Cabinet Stands, Lavatories, Plug Basins, Baths, Urinals, Closet Pans, Sinks, &c., &c., of the best quality.

Sole Makers of Buchan's Patent "Carmichael" Water Closet.

Also, Manufacturers of White and Tinted Glazed Earthenware Wall Tiles.

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DODD'S PATENT ANTI-FROST AUTOMATIC FLUSHING CISTERNS.
URINALS, LAVATORIES, &c.

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SMOKE PREVENTER AND COAL ECONOMISER

Can be applied to any Grate or Open Fire Range.

IT ENSURES—PERFECT COMBUSTION.
IT CURES— SMOKY CHIMNEYS, AND
IT BURNS— COKE, ANTHRACITE, & BITUMINOUS COAL WITH EQUAL FACILITY.

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WITH HYPOPHOSPHITES AND PANCREATINE,

(AS SUPPLIED TO THE PRINCIPAL HOSPITALS)

Is now largely prescribed by the Medical Profession, and has been pronounced by several distinguished Physicians the finest preparation of Cod Liver Oil that has ever been introduced.

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"Thomson's Cod Liver Oil Cream is an elegant form of emulsion, in which Hypophosphites of lime, &c., and Pancreatine are combined with the Cod Liver Oil in a fashion well adapted to suit the requirements of the most delicate stomach. Those who desire a preparation of Cod Oil agreeable to the taste, and thoroughly reliable as a restorative medicine, will find in this 'Cream' an admirable substitute for the pure oil. For children and invalids generally, this preparation must be highly commended."

THE COD LIVER OIL and other ingredients used in its preparation are guaranteed to be of the very finest quality. It is delicious to the taste, easily digested, and highly nutritious. As a heat-producing and fattening agent it is unsurpassed by any other nutrient, and is therefore strongly recommended for children and persons of delicate constitution, who are susceptible to cold. In obstinate cases of Coughs or Colds it affords great relief by its soothing effects on the throat and chest; and in Pulmonary Affections or Weakness of the Chest it is of the highest value, as it supplies, in the most easily assimilated form, the Oil which is considered most effective in preserving and strengthening the Lungs, and the Hypophosphites which arrest and repair waste in their delicate tissues.

All who are in a low state of health generally will do well to try it, and cannot fail to be greatly benefited by taking a course of it.

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"Since these excellent Ventilators have been introduced, we have now got PERFECT methods of Ventilation."

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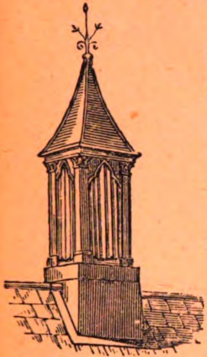

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"Information of a popular kind on Sanitary Science is much required by the public."

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